FINAL

RECORD OF DECISION
OPERABLE UNIT NO. 6
(SITES 36, 43, 44, AND 54)

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0219

JANUARY 2005

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under the:

LANTDIV CLEAN II Program
Contract N62470-95-D-6007

Prepared by:

CH2M HILL, INC.
Herndon, Virginia

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

TABLE OF CONTENTS

Page

TABLE OF CONTENTS
(Continued)

Page

TABLE OF CONTENTS
(Continued)

Page

TABLE OF CONTENTS
(Continued)

Page

TABLE OF CONTENTS
(Continued)

Page

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS
(Continued)

Page

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AST	Above Ground Storage Tank
AM	Action Memorandum
ARAR	Applicable or Relevant and Appropriate Requirements
Baker	Baker Environmental, Inc.
bgs	below ground surface
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIP	Community Information Plan
COC	Contaminants of Concern
COPCs	Contaminants of Potential Concern
DoD	Department of Defense
1,2-DCE	1,2-dichloroethene
EE/CA	Engineering Evaluation/Cost Analysis
EQB	Environmental Quality Branch
FFA	Federal Facilities Agreement
FS	Feasibility Study
HI	Hazard Index
HRC®	Hydrogen Releasing Compound
IAS	Initial Assessment Study
ILCR	Incremental Lifetime Cancer Risk
IR	Installation Restoration
IRA	Interim Removal Action
J	Analyte was positively identified, value is estimated
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
LTM	Long-Term Monitoring
LUC	Land Use Controls
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	Monitored Natural Attenuation
MW	Monitoring Well

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

Navy	Department of the Navy
NC DENR	North Carolina Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation
NCGS	North Carolina General Statutes
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCWQS	North Carolina Water Quality Standards
ND	Not Detected
NE	No Criteria Published
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
OHM	OHM Remediation Services
O&M	Operation and Maintenance
ORP	Oxygen Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
1,1,2,2-PCA	1,1,2,2-tetrachloroethane
PCB	Polychlorinated Biphenyl
POL	Petroleum, Oil, and Lubricants
ppm	parts per million
PRAP	Proposed Remedial Action Plan
QI	Quotient Indices
RAO	Remedial Action Objectives
RA	Risk Assessment
RAA	Remedial Action Alternative
RAB	Restoration Advisory Board
RAC	Remedial Action Contractor
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SB	Soil Boring
SI	Site Inspection
SMP	Site Management Plan
SSV	Sediment Screening Value
SSSV	Surface Soil Screening Value
SVOC	Semivolatile Organic Compound
SWSV	Surface Water Screening Value

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TBC	To Be Considered
TCE	Trichloroethene
TCRA	Time Critical Removal Action
TP	test pit
TRV	Terrestrial Reference Value
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 DECLARATION

1.1 Site Name and Location

Operable Unit No. 6
Sites 36, 43, 44, and 54
Marine Corps Base
Camp Lejeune, North Carolina
EPA ID: NC6170022580

1.2 Statement of Basis and Purposes

This Record of Decision (ROD) presents the selected remedy for Operable Unit (OU) No. 6 (Sites 36, 43, 44, and 54) at Marine Corps Base (MCB), Camp Lejeune, North Carolina. The selected remedies for OU No. 6 were made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) §300]. Because of elevated trichloroethene (TCE) concentrations in groundwater at Site 86, Site 86 was removed from OU No. 6 and reassigned to OU No. 20 in July 2000. Accordingly, Site 86 is not discussed in this ROD. This decision document was prepared in accordance with the United States Environmental Protection Agency (USEPA) decision document guidance (USEPA, 1999). This decision is based on the Administrative Record file for OU No. 6.

The Department of the Navy (Navy) and the Marine Corps have obtained concurrence from the North Carolina Department of Environment and Natural Resources (NC DENR) and approval from the USEPA Region IV on the selected remedies set forth in this ROD. A copy of the NC DENR concurrence letter dated _____, 2004 is included as Attachment A. Both the NC DENR and USEPA have indicated concurrence with the selected remedies by their signatures in this ROD (will be included in the Final ROD).

1.3 Assessment of the Sites

The response actions selected in the ROD are necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances from these sites.

1.4 Description of the Selected Remedies

OU No. 6 (Sites 36, 43, 44, and 54) is one of the 21 OUs that are part of the comprehensive environmental investigation and cleanup currently being performed at MCB, Camp Lejeune under the CERCLA program. This ROD addresses only OU 6 (Sites 36, 43, 44, and 54). The selected remedies eliminate unacceptable exposures to unknown buried materials (Sites 36, 43, and 44), previous removal action area (Sites 36 and 54), lead and polychlorinated biphenyls (PCBs) in soil (Site 36) and TCE, 1,1,2,2-tetrachloroethane, and vinyl chloride in Site 36 groundwater. The selected remedies include monitored natural attenuation (MNA) for groundwater and land use controls (LUCs) that will limit exposure to soil, prevent any residential reuse activities, and prohibit the use of groundwater only at Site 36, except for monitoring. The

selected remedies were determined based on the evaluation of site conditions, site related risks, applicable or relevant and appropriate requirements (ARARs), and remedial action objectives (RAOs).

The major components of the selected remedies are as follows:

Site 36

Soil

- Filing a Notification of Inactive Hazardous Substance or Waste Disposal per North Carolina General Statutes (NCGS) 130A-310.8.

- LUCs (Figure 1-1) will prohibit intrusive activities and development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the former dump, lead areas, and previous soil removal action areas.

Groundwater

- MNA will be performed by collecting and analyzing groundwater samples to assess that no unacceptable contamination migration is occurring and to evaluate reductions in contaminant concentrations through naturally occurring processes such as biodegradation, dispersion, and dilution.

- LUCs will prohibit the withdrawal and/or future use of water, except for monitoring, from the aquifers (surficial and Castle Hayne) within 1,000 feet of the identified groundwater plume (Figure 1-1). The LUC will also prohibit intrusive activities within the extent of current groundwater contamination unless specifically approved by both NC DENR and USEPA.

Site 43

Soil

- Filing Notification of Inactive Hazardous Substance or Waste Disposal per NCGS 130A-310.8.

- LUCs (Figure 1-2) will prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the previous soil removal action area.

- LUCs will prohibit intrusive activities within the entire site boundary.

Groundwater

- None

Site 44

Soil

- Filing a Notification of Inactive Hazardous Substance or Waste Disposal per NCGS 130A-310.8.

- LUCs (Figure 1-3) will prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the previous soil removal action area.

- LUCs will prohibit intrusive activities within the entire site boundary.

Groundwater

- None

Site 54

Soil

- Filing a Notification of Inactive Hazardous Substance or Waste Disposal per NCGS 130A-310.8.

- LUCs (Figure 1-4) will prohibit intrusive activities and development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the area of the former burn pit.

Groundwater

- None

Site conditions will be reviewed every 5 years. If MNA and/or LUCs are shown to be insufficient, other remedial approaches will be evaluated and may be implemented. Due to the lengthy projected time frame for reaching cleanup goals for groundwater, periodic reviews of new technologies which, may address volatile organic compounds (VOCs) in groundwater, may be conducted in conjunction with the five-year review at Site 36.

The Navy shall prepare in accordance with USEPA Guidance and submit to the USEPA and NC DENR, a Remedial Design (RD) containing LUC implementation actions in accordance with the schedules in the Federal Facilities Agreement (FFA). The Navy shall also submit the document memorializing remedial action completion within 120 days following completion of the remedial action for each OU.

The LUCs shall be maintained for as long as they are required to prevent unacceptable exposures to contaminated soil and groundwater or to preserve the integrity of the remedy. The LUCs shall be maintained until the concentrations of hazardous substances in the soils and groundwater are at such levels to allow for unlimited exposure and unrestricted use. The Navy will be responsible for implementing, inspecting, reporting, and enforcing the LUCs described in this ROD in accordance with the approved LUC RD.

1.5 Statutory Determinations

The selected remedies are protective of human health and the environment, are cost effective, and comply with Federal and state requirements that are legally applicable or relevant and appropriate to remedial action. The selected remedies will provide protection of human health by preventing potential exposure to contaminants and wastes at Sites 36, 43, 44, and 54 through LUCs and/or MNA. The nature of the selected remedy for Site 36 is such that ARARs will eventually be met through MNA for groundwater.

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at this site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment. Although the selected remedy does not provide for treatment as the principal element, reduction of groundwater contaminant concentrations are expected over time due to dispersion, advection, and adsorption processes.

The selected remedies will result in hazardous substances, pollutants, or contaminants remaining onsite, above levels that allow for unlimited use and unrestricted exposure. Therefore, a statutory review will be conducted within 5 years after the initiation of the remedial action to ensure that the remedy is protective of human health and the environment.

1.6 Record of Decision Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for MCB, Camp Lejeune OU 6.

- Chemicals of concern (COCs) and their respective concentrations
- Baseline risk represented by the COCs
- Cleanup levels established for COCs and the basis for these levels
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD
- Potential land and groundwater use that will be available at the site as a result of the selected remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected
- Key factors that led to selecting the remedy (i.e., a description of how the selected remedy provides the best balance of trade offs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)
- Selected Remedy

1.7 Signature and Support Agency Acceptance of Remedy

Robert C. Dickerson — 20 MAY 2005

Major General Robert C. Dickerson — Date
Commanding General
Marine Corps Base, Camp Lejeune

6-21-05

Dexter R. Matthews, Director — Date
Division of Waste Management
North Carolina Department of Environment and Natural Resources

7-6-05

Winston A. Smith, Director — Date
Waste Management Division
U.S. Environmental Protection Agency - Region 4

Encl(2)

2.0 DECISION SUMMARY

This ROD describes the Navy's and the USEPA's selected remedial actions for OU No. 6 (Sites 36, 43, 44, and 54) at MCB, Camp Lejeune, North Carolina. The Navy is the lead agency and provides funding for site cleanups. OU No. 6 is one of 21 OUs located within MCB, Camp Lejeune. In the case of OU No. 6, Sites 36, 43, 44, and 54 were grouped together because of their close geographic proximity. Figure 2-1 depicts the locations of all four sites that comprise OU No. 6: Site 36 (Camp Geiger Area Dump), Site 43 (Agan Street Dump), Site 44 (Jones Street Dump) and Site 54 (Crash Crew Fire Training Burn Pit). As shown, OU No. 6 is located within the Camp Geiger (Site 36) and Marine Corps Air Station (MCAS) New River portions of the Base.

The Public Meeting for OU No. 6 was held on June 18, 2002. The remedies selected as detailed in the Final Proposed Remedial Action Plan (PRAP) were presented at the meeting. Due to the national debate between the USEPA and Department of Defense (DoD) regarding enforcement issues of the LUCs, completion of the Final ROD was pending. Accordingly, an Action Memorandum (AM) was also presented at the Public Meeting for completing interim removal action (IRAs) as an alternative plan to completing the ROD remedial actions. An Engineering Evaluation/Cost Analysis (EE/CA) was completed in October 2002 as part of the IRA for Sites 36 and 43. The Final AM was also signed in December 2002. The IRAs, which included the removal of impacted soils at Sites 36 and 43, were also completed in 2003. The final remedial actions for OU No. 6 are LUCs and MNA. The Decision Summary for each individual site included in the OU is presented separately in the following sections of this document. The Decision Summary compares the proposed Remedial Action Alternatives (RAAs) with the seven criteria presented in Table 2-1. Community and state acceptance of the selected alternatives are presented in Section 11.0 of this ROD. The proposed RAAs for each of the four sites are presented in Table 2-2.

3.0 ENFORCEMENT ACTIVITIES

MCB, Camp Lejeune was placed on the CERCLA National Priorities List (NPL) effective November 4, 1989 (54 Federal Register 41015, October 4, 1989). Subsequent to this listing in March 1991, the USEPA Region IV, the NC DENR, the Navy, and the Marine Corps entered into a FFA for MCB, Camp Lejeune. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at the Base were thoroughly investigated and that appropriate CERCLA response and Resource Conservation and Recovery Act (RCRA) corrective action alternatives were developed and implemented, as necessary, to protect public health and welfare, and the environment (MCB, Camp Lejeune FFA, 1991). No enforcement activities have been recorded to date at Sites 36, 43, 44, and 54.

4.0 COMMUNITY PARTICIPATION

The MCB, Camp Lejeune Restoration Advisory Board (RAB) was formed in 1996. Meetings are held to provide an information exchange among community members, the USEPA, NC DENR, the Marine Corps, and the Navy. These meetings are open to the public and are held about every 3 months. A Community Information Plan (CIP) is being updated through the Installation Restoration (IR) process.

In accordance with Sections 113 and 117 of CERCLA, MCB, Camp Lejeune and the Navy provided a public comment period from June 18, 2002 to July 18, 2002 for the proposed remedial actions described in the Revised Feasibility Study (FS), EE/CA, PRAP, and AM for OU No. 6 (Sites 36, 43, 44 and 54). No comments were received from the public during the comment period. The FS, EE/CA, PRAP, and AM are available to the public in the Administrative Record file and information repository maintained at the MCB, Camp Lejeune Library.

A Public Meeting was held at the Coastal Carolina Community College on June 18, 2002 to present the RAAs as described in the PRAP, for OU No. 6 (Sites 36, 43, 44, and 54). The IRAs proposed for Sites 36 and 43 were also presented at the meeting per the EE/CA and AM. As discussed in this ROD, the IRAs were performed for elevated polycyclic aromatic hydrocarbons (PAHs) and pesticides in soil at Site 36 and PAHs in soil at Site 43. Public notice of the meeting and availability of documents was placed in the Jacksonville Daily newspaper on June 16, 2002. No comments were received outside of the Public Meeting.

5.0 SITE 36 - CAMP GEIGER AREA DUMP

5.1 Site Description and History

Site 36 is located approximately 1,000 feet east of Camp Geiger and 500 feet west of the New River, adjacent to the former Camp Geiger Sewage Treatment Plant. Camp Geiger is situated directly north of MCAS, New River, and approximately 3 miles southwest of Jacksonville, North Carolina. Figure 5-1 shows the features of Site 36. The site encompasses nearly 20 acres and is comprised primarily of open fields and wooded areas. A gravel road bisects the site and provides access to Jack's Point Recreation Area, located approximately one-quarter mile to the east. The site is bordered to the north and east by Brinson Creek and a wooded area, to the south by an unnamed tributary to the New River, and to the west by an improved (i.e., coarse gravel) road. Further to the west of the improved road lies an abandoned railroad right-of-way, once part of the Seaboard Coastline Railroad.

Site 36 is reported to have been used for the disposal of municipal wastes and mixed industrial wastes including trash, waste oils, solvents, and hydraulic fluids that were generated at MCAS, New River. The dump was active from the late 1940s to the late 1950s. Most of the material was burned and buried; however, some unburned material was also buried. Reportedly, less than five percent of all waste hydrocarbon material generated at MCAS, New River was disposed at Site 36.

Parts of the site have been changed due to the construction of the North Carolina Department of Transportation (NCDOT) Route 17 bypass project. Several of the gravel roads that ran through the site have been widened and the elevation raised, serving as the subgrade for the Route 17 bypass. The Route 17 bypass construction extends outside the boundaries of the Site 36 study area and lies to the west of the site.

5.2 Previous Investigations

5.2.1 Initial Assessment Study

An Initial Assessment Study (IAS) was conducted at MCB, Camp Lejeune and MCAS, New River in 1983. The IAS evaluated the potential hazards at various sites throughout the Base, including Sites 36, 43, 44, and 54. The evaluation included a review of historical records, aerial photographs, inspections, and personnel interviews. Sampling of any media was not conducted. The IAS for Site 36 concluded that due to the indication that hazardous substances were disposed at the site, a Confirmation Study was recommended.

5.2.2 Confirmation Study

A two-part Confirmation Study was conducted at Site 36 from 1984 through 1987. The study consisted of a Verification Step performed in 1984 and a Confirmation Step performed in 1986 and 1987. Field activities included groundwater, surface water, and sediment investigations.

Based on the results of the Confirmation Study at Site 36, it was recommended that further characterization of shallow and deep groundwater be implemented through a Remedial Investigation/Feasibility Study (RI/FS) due to VOCs and metals.

5.2.3 RI Scoping Investigation

An RI Scoping Investigation was conducted at Site 36 in 1994. Following the identification of 11 abandoned containers (5-gallon containers and 55-gallon drums) during the March 1994 initial site survey, a limited drum and soil sampling program was proposed to address potentially impacted media. During the intervening months between the initial site survey and the drum investigation, a majority of the containers were removed from the study area by unidentified personnel. Accordingly, only four five-gallon containers were sampled during the investigation. These four containers were located near the south central portion of the study area. Results of the analyses of the substance in the containers and visual inspections indicated that the material was a weathered paint product.

5.2.4 Aerial Photographic Investigation

Surface conditions at Site 36 were examined via black-and-white aerial photographs taken in 1949, 1956, 1960, 1964, and 1970. Visual data from these photographs were used to evaluate previous site operations and potential source areas of contamination. Additional photographs from 1938 and 1943 were used to establish a basis of comparison, as they depicted the area prior to development of the Camp Lejeune Military Reservation.

5.2.5 Remedial Investigation/Feasibility Study

From February through May 1995, an RI was conducted at Site 36. The RI consisted of soil, groundwater, surface water and sediment investigation, an aquatic investigation, and habitat evaluation.

The preferred remedial action for Site 36, as originally introduced in the 1998 (Baker, 1998a) FS, was based on the nature and extent of contamination and the potential risks to human health and/or the environment. MNA was selected as the preferred RAA for Site 36 groundwater to address the VOCs detected in the aquifers at concentrations exceeding North Carolina Water Quality Standards (NCWQS) and/or Federal Maximum Contaminant Levels (MCLs). These VOCs include TCE, 1,1,2,2-tetrachloroethane (1,1,2,2-PCA) and vinyl chloride. This alternative was also recommended in the Revised FS Report in 2002 (Baker, 2002d). A preferred alternative was also developed for lead, PAHs and pesticides in soil in the Revised FS. PAHs and pesticides in soil were subsequently addressed during the IRA performed during 2003 as described below (refer to Section 5.2.10).

5.2.6 Time Critical Removal Action

A Time Critical Removal Action (TCRA) was performed at Site 36 in 1997 based on the results of the RI. Results of the RI at Site 36 found that the surface soil at several locations presented an imminent threat to human health and the environment. The PCB impacted area was located in the northwest region of the site at the intersection of two dirt roads. The TCRA included excavation of 92 tons of regulated PCB-contaminated soils and approximately 148 tons of non-regulated PCB-contaminated soils.

5.2.7 Groundwater Monitoring Program

The post-RI groundwater monitoring program at Site 36 began in October 1998 with the quarterly collection of both groundwater and surface water samples. Groundwater sampling is ongoing at

this site and is now conducted on a semiannual basis. Post-RI monitoring was implemented to determine if MNA could be a viable remedial alternative for this site and to monitor the plume movement.

5.2.8 Temporary Well Investigation

Three temporary groundwater monitoring wells were installed across Brinson Creek from Site 36 on private property to determine if contamination related to Site 36 had migrated under Brinson Creek. TCE was not detected in these wells. Refer to the Temporary Well Investigation Letter Report (Baker, 2000) for details of this investigation.

5.2.9 Geoprobe® Investigation

During October 2002, a Geoprobe® investigation was conducted at Site 36 to assist in locating new monitoring wells to support the MNA remedy and to further delineate the contaminant plume. Results of this investigation have also been incorporated into the Long-Term Monitoring (LTM) program.

5.2.10 Interim Removal Action

An IRA was completed at Site 36 in 2003, prior to the Final ROD. The primary focus of the IRA was the removal of PAH and pesticide contaminated soil in four areas within the south central portion of the site. A total of 1629.9 tons of soil was excavated during the removal action. Refer to the AM (Baker, 2002a), EE/CA (Baker, 2002c), Revised FS (Baker, 2002d), PRAP (Baker, 2002e), and the IRA Close Out Report (Shaw, 2003) for further details of the IRA.

5.3 Scope and Role of Response Actions

The scope of the preferred remedial actions for OU No. 6 includes the separate preferred alternatives selected for all four sites contained within OU No. 6 (Sites 36, 43, 44, and 54).

A list of all IR sites, including Sites 36, 43, 44, and 54, can be found in the Fiscal Year 2004 Site Management Plan (SMP), which is located in the Administrative Record. The SMP contains the location, description, contaminants of concern, and cleanup status of each site. As of April 2004, 42 sites or 21 OUs are included in the IR Program at MCB, Camp Lejeune. The LTM program has been in operation since 1995 under the IR Program. Four sites have been permanently removed from LTM since 1995. As of April 2004, 14 sites are included in the LTM program, of which seven sites have signed RODs or Interim RODs. LTM is also being performed at other non-ROD sites to collect post-RI data in support of the final remedy.

The greatest risks posed by Site 36 are related to the former disposal area, lead contaminated areas, and previous removal action areas. In addition, groundwater is contaminated with VOCs. Intrusive activities or residential development in these areas could pose a threat through direct contact with contamination. Drinking groundwater from beneath the site could pose a threat to human health. The risks posed by these potential threats were quantified in the human health and the ecological RAs (Baker, 1996).

Creating LUCs and performing MNA provide the best alternatives for eliminating current and future exposure pathways. The LUC objectives are:

- Prohibit intrusive activities and residential development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the former dump, lead areas, and previous soil removal action areas.

- Prohibit the withdrawal and/or future use of water, except for monitoring, from the aquifers (surficial and Castle Hayne) within 1,000 feet of the identified groundwater plume. The LUC will also prohibit intrusive activities within the extent of current groundwater contamination unless specifically approved by both NC DENR and USEPA.

Within 120 days following the execution of this ROD, the Navy shall develop a RD document that shall contain LUC implementation and maintenance actions, including periodic inspections and LTM.

5.4 Site Characteristics

5.4.1 Site Overview

OU No. 6 is located within the northwestern portion of the Base. Site 36 is located approximately 1,000 feet east of Camp Geiger and 500 feet west of the New River, adjacent to the Camp Geiger Sewage Treatment Plant.

5.4.2 Surface and Subsurface Features

There are no underground storage tanks (USTs), above ground storage tanks (ASTs), or drum storage areas within the boundary of Site 36. In addition, there are no surface structures at this site, as it is heavily wooded.

5.4.3 Sampling Strategy

Samples collected to support the human health risk assessment (RA) and the ecological RA for Site 36 are shown on Figure 5-1. Provided in Attachment B are the RI and Post-RI Results. Table B-1 summarizes the analytical results from the RI. The results of the RI are also summarized in the Final RI Report (Baker, 1996). Table 5-1 provides the final groundwater COCs and remedial goals.

Results from post-RI investigations can be found in the following documents:

- Temporary Well Investigation Letter Report (Baker, 2000)
- LTM Reports (Baker, 2002b)

Table B-2 shows groundwater detections at Site 36 from 1998 through October 2002 and the applicable NCWQS. Figure 5-2 shows the footprint of the contaminants in the northern portion of the study area bordering Brinson Creek during October 2002. The extent of VOC contamination in groundwater is limited to the area indicated in Figure 5-2.

5.4.4 Source of Contamination

The main source of contamination at Site 36 is the solid waste placed in the former dump and the northern portion of the site.

5.4.5 Types of Contamination

Site 36 COCs are lead in soil, and TCE, 1,1,2,2-PCA, and vinyl chloride in groundwater. PCBs, PAHs, and pesticides in soil have been removed through the TCRA and IRA, as discussed in Section 5.2. Tables B-1 and B-2 present the analytical data summaries from the RI and post-RI groundwater monitoring.

5.4.6 Location of Contamination and Routes of Migration

5.4.6.1 Lateral and Vertical Extent of Contamination

The lateral and vertical extent of contamination at Site 36 was delineated through previous investigations at this site as described in Section 5.2. Exploratory test pits and soil borings were completed during RI site activities to assess the nature and extent of any buried material within suspected disposal areas. The locations of exploratory test pits and soil borings are shown on Figure 5-1. The test pits were completed primarily in the eastern portion of the site (roughly 3 to 5 acres) where the former wastes were dumped.

The lateral extent of VOC contamination in groundwater is limited to the area shown in Figure 5-2. Based on the groundwater data, an area of about 2.5 acres (less than 10% of the site area) has been impacted. The vertical extent of VOC groundwater contamination at Site 36 is limited to the intermediate monitoring wells that extend to a depth of 35 feet below ground surface (bgs).

5.4.6.2 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

The following potential current receptors were assessed during the human health RA for the RI: military personnel, recreational fishermen, and recreational users of the site surface water, trespassers, and construction workers. Receptor exposure to surface soil, surface water, sediment, fish tissue, and crab tissue was evaluated. Groundwater for current residents (future residents were considered) was not included since the current Base residents obtain potable water via the Base's public water distribution system.

5.4.7 Aquifer Characteristics

MCB, Camp Lejeune is located in the Atlantic Coastal Plain physiographic province. The sediments of this province may be of marine or continental origin and consist primarily of sand, silt, clay, shell beds and gravel. These sediments are found in interfingering beds and lenses that gently dip and thicken to the southeast. The combined thickness of these sediments beneath the Base is approximately 1,500 feet. The aquifers of primary interest at the Base and OU No. 6 are the surficial aquifer and the aquifer immediately below it, the Castle Hayne aquifer. Between the surficial and the Castle Hayne aquifers, where present, lies the Castle Hayne confining unit.

Additional aquifer characteristics are presented in the Final RI Report for OU No. 6 (Baker, 1996).

5.5 Current and Potential Future Site and Resource Uses

5.5.1 Current Site Land Uses

Site 36 is located in a wooded area of the Base. The site area is not being used for residential activities. Receptors at the site could include trespassers, military personnel, and fishermen. These receptors were considered in the human health RA.

5.5.2 Current Adjacent Site Land Uses

Site 36 is located within the Camp Geiger area. Camp Geiger contains a mixture of troop housing, personnel support and training facilities. The majority of the land surrounding this area is comprised of buffer zones and unbuildable marshland. Supply and storage facilities, which are concentrated along the eastern edge of the developed area and in the central portion, covers about 50 acres of land. Maintenance buildings, which cover about 19 acres, are located adjacent to the supply/storage areas. Combined, supply/storage and maintenance areas account for nearly 32 percent of the developed land in Camp Geiger. No family housing exists at Camp Geiger. Recently, the Route 17 bypass was constructed south and west of Site 36.

5.5.3 Anticipated Future Land Uses

The Base does not currently intend to build on Site 36, thereby eliminating potential exposure to the surface and subsurface soil by intrusive activities (e.g., excavations). Current land uses are anticipated to be consistent with the remedy.

5.5.4 Current Groundwater and Surface Water Uses

The MCB, Camp Lejeune Wellhead Protection Plan – 2002 (AH, 2002) was reviewed to determine the status of water supply wells near Site 36. Based on this report, there are no active potable water supply wells located within or near the boundary of Site 36. However, there are active potable water supply wells located within a one-mile radius of the site. Water supply wells PSWTC-600, PSWTC-1253, PSWAS-190 and PSWAS-191 are located west and southwest of the site. The distance of the supply wells to the site ranges from 3,600 feet to 5,400 feet and are located hydraulically upgradient of the site. Therefore, even though some of these supply wells are located within a one-mile radius of the site, it is not expected that they will be impacted by Site 36.

Shallow groundwater is not currently used as a potable source at the Base. Base residents obtain potable water via the Base's public water distribution system, which obtains the drinking water from the deeper Castle Hayne aquifer.

Brinson Creek borders Site 36 to the north and east. Potential surface water receptors considered in the human health RA are recreational fishermen and recreational users of the site surface water. Based on the current location of the VOC plume (Figure 5-2), and the direction of groundwater flow, contaminants from Site 36 are believed to be migrating to Brinson Creek.

5.5.5 Future Uses of Ground/Surface Water

Potential beneficial uses of groundwater and surface water are expected to be the same as the current uses identified above. The remedial action plan for Site 36 would prohibit use of the

groundwater aquifers (surficial and Castle Hayne) beneath the site for any purpose other than environmental monitoring and testing. No additional surface water uses are anticipated.

5.6 Summary of Site Risks

As part of the RI, human health and ecological RAs were conducted to determine the potential risks associated with the chemical constituents detected at Site 36 (Baker, 1996). The risks discussed below were calculated based on analytical data from the RI and do not consider the soil removal actions (TCRA and IRA) that have occurred at Site 36 after the RI. The soil removal actions performed after the RI have removed COCs in surface soil (except for lead). The following subsections briefly summarize the findings of the human health and ecological RAs from the RI. Provided in Attachment C are the human health and ecological RA tables.

5.6.1 Human Health Risk Assessment

The human health RA estimates what risks the site poses if no remedial actions are taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the human health RA for Site 36. Refer to the RI (Baker, 1996) for further details of the human health RA.

During the human health RA, current and future potential receptors (including current military personnel [exposure of four years], current trespassers [i.e., children and adults], future residents [i.e., children and adults assuming exposure for 30 years], a current and future fisherman, and current and future construction workers) were evaluated for possible exposure to site media. The total risk from the site to these receptors was estimated by logically summing the multiple pathways likely to affect the receptor during a given activity. Exposure to surface soil, surface water, and sediment was assessed for current trespassers. Military receptors were assessed only for surface soil risks. Fish and crab tissue ingestion was only evaluated for the fisherman. Subsurface soil, groundwater, surface water, and sediment exposures were evaluated for all of the future receptors. Table C-1 presents the contaminants of potential concern (COPCs) evaluated during the human health RA. The selection of these COPCs was based on criteria provided in the USEPA Risk Assessment Guidance for Superfund. For each COPC, Incremental Lifetime Cancer Risk (ILCR) and Hazard Index (HI) values were calculated to quantify potential carcinogenic and noncarcinogenic risks, respectively.

Potential risk is identified when the risk calculations exceed the USEPA ILCR target risk range of 1×10^{-6} to 1×10^{-4} for carcinogens and HI values greater than or equal to 1.0 for noncarcinogenic contaminants. The contaminants that cause potential risk are considered to be COCs.

5.6.1.1 Current Scenario

The following potential current receptors were assessed: military personnel, recreational fishermen, recreational users of the site surface water, trespassers, and construction workers. Receptor exposure to surface soil, surface water, sediment, fish tissue, and crab tissue was evaluated. Groundwater was not included since the Base residents obtain potable water via the Base's public water distribution system. The potential risks associated with potential receptors, excluding the fisherman, however, were within target risk levels. For the current fisherman, the total noncarcinogenic risk (9.1) and total carcinogenic risk (1.1×10^{-3}), mainly from fish and crab tissue ingestion, were greater than the target risk levels of 1.0 and 1×10^{-4} for noncarcinogenic and

carcinogenic effects, respectively. The levels of arsenic and mercury found in the fish tissue and the maximum levels of arsenic and lead detected in the crab tissue contributed to these risks. Exposure to the maximum concentration of lead in the surface soil and crab tissue for a child receptor also indicates the potential for adverse health effects.

The maximum level of arsenic was detected in a white catfish fillet sample and the maximum level of mercury was found in a largemouth bass fillet sample. These two samples represent fish typically caught and ingested by residents of the area. Crabbing may be less prevalent than recreational fishing in the area because access to the site surface water where crabs are more abundant is limited. These inorganics were also detected in the underlying sediment; however, they were detected at levels below the National Oceanic and Atmospheric Administration (NOAA) screening values and they were not found in the surrounding surface water.

In November of 1997, the Division of Water Quality of the NC DENR submitted a letter to MCB, Camp Lejeune to inform the Base of the ongoing NC DENR fish collection and tissue sampling from the Brinson Creek area. The state abandoned the efforts as both the low flow and high salinity conditions hindered the collection attempts.

5.6.1.2 Future Scenario

Future potential child and adult residents were assessed for possible exposure to groundwater, subsurface soil, surface water, and sediment. A construction worker was evaluated for subsurface soil exposure. There were no unacceptable risks associated with the construction worker exposure scenario. However, there were potential noncarcinogenic risks (i.e., 1.0) calculated for the child resident from groundwater (5.2, ingestion and dermal contact) and subsurface soil (2.3) exposure. Similarly, there was a noncarcinogenic risk (2.2) calculated for the adult resident from groundwater exposure. These risk values exceeded the target risk value of 1.0 for noncarcinogenic effects. The maximum level of iron in groundwater contributed to these risks. In terms of lead effects, exposure to the maximum concentration of lead in the subsurface soil for a child receptor indicates the potential for adverse health effects.

In addition, iron is an essential nutrient. The toxicity values associated with exposure to this metal are based on provisional studies, which have not been verified by USEPA. In fact, if iron were removed from the evaluation of risk from groundwater ingestion, the noncarcinogenic risk for the child would decrease from 5.2 to 1.5 and, for the adult, from 2.2 to 0.7. Similarly, if iron were removed from the evaluation, the noncarcinogenic risk from exposure to subsurface soil for the child receptor would decrease to target risk values (i.e., 2.3 to 0.9). As a result, the potential human health risk from exposure to iron in groundwater and subsurface soil is a conservative estimate.

The iron concentrations detected in groundwater ranged from 0.003 milligram per liter (mg/L) to 16.9 mg/L. The iron concentrations detected in the site soil, however, are within typical concentrations noted in literature values for similar media and MCB, Camp Lejeune.

The groundwater at Site 36 is not used as a potable source, and the highway impact of U.S. Route 17 bypass makes future residential development of the site unlikely. Furthermore, there are no potable supply wells within the immediate vicinity of the site. Based on this information, future exposure to groundwater is unlikely to occur.

5.6.2 Summary of Ecological Risk Assessment

The subsections which follow detail the ecological risks to aquatic and terrestrial receptors posed by potential exposure to various site media. Table C-2 lists the COPCs evaluated during the ecological RA. Refer to the RI (Baker, 1996) for further details of the ecological RA.

5.6.2.1 Aquatic Ecosystem

Based upon the assessment of ecological risks, there is a slight potential for inorganics in the surface water and sediment, and a moderate potential for pesticides (4,4'-DDD and 4,4'-DDT) and diethylphthalate in the sediment, to decrease the population of aquatic life at the freshwater stations. There is a very slight potential for inorganics in the surface water (copper, nickel), and a moderate potential for inorganics (lead), pesticides (4,4'-DDD and 4,4'-DDE), and diethylphthalate in the sediment, to decrease the population of aquatic life at the saltwater stations. Pesticides reportedly have not been stored or disposed at Site 36. Therefore, the probable source of the pesticides in the sediment is the widespread application of pesticides that was conducted for pest control at MCB, Camp Lejeune.

The high lead concentration in the sediment was detected in the sample collected adjacent to the site. The source of the high lead concentration is not known. Based upon additional sediment sampling, it appears that the high lead concentration may have been an anomaly and does not appear to be indicative of widespread site concentrations. Naturally high lead concentrations in soil and sediment does not indicate history of dumping or use at the Base.

Overall, the contaminants in the surface water and sediment have a slight potential to reduce the aquatic receptor population. There is a very slight potential for inorganics in the surface water (copper, nickel), and a moderate potential for inorganics (lead), pesticides (4,4'-DDD and 4,4'-DDE), and diethylphthalate in the sediment, to decrease the population of aquatic life at the saltwater stations. The benthic macroinvertebrates do not appear to be impacted based upon the results of the benthic study. Some of the contaminants in the fish tissue are elevated. Due to the lack of toxicological data, the potential risk to the fish from those contaminants cannot be evaluated.

5.6.2.2 Terrestrial Ecosystem

Several organic compounds and inorganics were detected at concentrations that exceeded applicable surface soil screening values (SSSVs). A comparison of chronic daily intake (CDI) versus terrestrial reference values (TRVs) was also performed for Site 36. The CDI exceeded the TRV for all five terrestrial species evaluated. The potential exposure risks for the cottontail rabbit and raccoon were the highest. The risks to these species are due to organics (pesticides) and inorganics (cadmium) rather than one specific contaminant risk driver.

Aldrin, dieldrin, 4,4'-DDD, and 4,4'-DDE were the only pesticides detected in the whole body fish tissue samples at concentrations above the proposed piscivorous wildlife criteria. The pesticides may have accumulated as a result of exposure to sediment at Site 36. None of the pesticides generated a risk for the raccoon from ingesting the fish. Lead in the fish and crabs were slightly elevated versus the background samples. These levels, however, did not cause a risk to the raccoon ingesting the fish. Cadmium was the only metal detected in the whole-body tissue samples above the wildlife dietary levels that posed a risk to the raccoon. The cadmium in the tissue samples does not appear to be site-related.

Benzo(a)pyrene was detected at Site 36, but had localized detections that exceeded screening levels so it was not considered as a COC in the 2002 FS.

Some potential impacts to soil invertebrates and plants may occur as a result of potential exposure to site contaminants. There is also a slight potential for a decrease in the terrestrial vertebrate population from exposure to site contaminants based on the terrestrial intake model. It should be noted, however, it should be noted that the SSSVs incorporates inherent uncertainty into the evaluation of ecological risks.

5.7 Remedial Action Objectives

RAOs are medium-specific goals that the remedial actions are expected to accomplish to protect human health and the environment. They guide the formulation and evaluation of remedial alternatives. The level of contamination and the potential exposure routes were considered in defining the site-specific RAOs for protecting human health and the environment. The selected remedial actions identified for Site 36 are expected to meet the site-specific RAOs that were developed in the FS for contaminated surface soil, subsurface soil, and groundwater.

Originally, Site 36 included a RAO for the PAH and pesticide contaminated surface and subsurface soil; however, these contaminated soils were removed during the IRA performed in 2003. Therefore, the following RAOs will protect human health and the environment from the former dump, lead in soil, former PCB, PAH and pesticide soil removal areas, and VOCs in groundwater:

- Protect human health by preventing exposure to surface and subsurface soil within the following areas: lead contaminated areas, unknown disposal materials within the former dump, and the previous soil removal action areas (i.e., PCB, PAH and pesticide removal action areas).

- Prevent future exposure to VOC contaminated groundwater and assess natural attenuation of groundwater contamination.

- Protect uncontaminated groundwater for future potential beneficial use.

5.8 Description of Alternatives

The current land use of Site 36 is anticipated to continue indefinitely. However, residential and industrial land use alternatives are considered. Residential land use RAAs would allow for future land uses such as housing, schools, parks, marinas, and/or office building uses. Industrial land use RAAs would allow for future land uses such as non-office warehouses, equipment storage facilities, and/or electrical substations (Baker, 2002d).

Site 36 RAAs were developed by combining the remedial action technologies and process options identified in the FS. Lead is present in soil at levels above the EPA action level of 400 parts per million (ppm). In addition, the site was a former dump and removal actions for PCB, PAHs and pesticides in soil have been performed. Therefore, the no action RAA and LUCs RAA are presented for soil. Three RAAs were developed to address groundwater contamination detected at Site 36. These include the no action RAA for groundwater and two RAAs for groundwater that exceed the NCWQS.

These RAAs represent a wide range of response actions, remediation goals, potential land uses, LUCs, and remediation costs as presented in the Final Revised FS. A summary table that presents a description, allowable land uses, LUCs required, and cleanup goals for each RAA is provided as Table 2-2.

Soil

36S RAA 1:	No Action	$0
36S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Lead Contaminated Areas, Former Dump Area, and Previous Removal Action Areas (refer to Table 5-2)	$48,352

Groundwater

36GW RAA 1:	No Action	$0
36GW RAA 2:	Enhanced Natural Attenuation and Land Use Controls for Groundwater	$691,000
36GW RAA 3:	Monitored Natural Attenuation and Land Use Controls for Groundwater (refer to Table 5-3)	$409,966

The following paragraphs briefly describe these alternatives.

5.8.1 36S RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to reduce the toxicity, mobility, or volume of contaminants identified in soil at Site 36. In addition, no LUCs such as intrusive activity restrictions or land use restrictions will be implemented at the site. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Although this RAA does not involve physical remediation, remediation of the soil contamination is expected to occur over time via natural attenuation of contaminants. These processes include naturally occurring biodegradation, volatilization, dilution, leaching, adsorption, and chemical reactions between subsurface materials. Under the No Action RAA, however, no means are provided to monitor or confirm the natural remediation process.

Since contaminants will remain at Site 36 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

5.8.2 36S RAA 2: LUCs for Surface and Subsurface Soil for Lead Contaminated Areas, Former Dump Area, and Previous Removal Action Areas

36S RAA 2 includes LUCs for lead contaminated areas because lead contaminated soil poses a potential human health risk. In addition, it is necessary to prevent future exposure to the former dump, and the previous PCB, PAH and pesticide soil excavation areas through land use restrictions. LUCs can be implemented at this site to minimize exposure to potential hazards from contamination in surface and subsurface soils at the site. Under this RAA, defining areas that will have LUCs placed on them will minimize exposure to contaminated soil. LUCs will prohibit intrusive activities and development and use of property for residential housing,

elementary and secondary schools, child care facilities and recreational areas within the former dump, lead areas, and previous soil removal action areas. These restrictions will remain in place until it can be demonstrated that the remediation cleanup goals are achieved.

Lead contamination at Site 36 is concentrated in soils in the southeastern corner of the site. The EPA residential action level for lead in soil is 400 ppm. Therefore, any sampling location exceeding this concentration will need to be designated with LUCs. There are only three surface soil locations with a lead concentration above this action level. The majority of the lead contamination is in subsurface soils. The area of the PCB TCRA is located in the northwestern portion of the site. The former dump area is located in the eastern portion of the site, and the PAH and pesticide IRA areas are located in the central portion of the site. Figure 5-3 shows the areas to be designated with LUCs at Site 36.

Since contaminants will remain at Site 36 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

5.8.3 36GW RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to reduce the toxicity, mobility, or volume of contaminants identified in the groundwater at Site 36. In addition, no LUCs such as aquifer use restrictions or land use restrictions will be implemented at the site. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Although this RAA does not involve physical remediation, remediation of the groundwater contamination is expected to occur over time via natural attenuation of contaminants. These processes include naturally occurring biodegradation, volatilization, dilution, leaching, adsorption, and chemical reactions between subsurface materials. Under the No Action RAA, however, no means are provided to monitor or confirm the natural remediation process.

Since contaminants will remain at Site 36 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

5.8.4 36GW RAA 2: Enhanced Natural Attenuation and Land Use Controls for Groundwater

Under 36GW RAA 2 for groundwater, a hydrogen release compound (HRC®) will be injected into the groundwater to reduce the toxicity, mobility, and volume of the groundwater contaminants at Site 36. HRC® is a slowly dissolving polymer that releases hydrogen to accelerate the reductive dechlorination of TCE contamination at Site 36. Pilot tests of a site in New Jersey with TCE contaminated groundwater used direct push injection, with monitoring wells, to effectively complete this treatment (Koenigsberg, 2000). The site will be monitored by sampling monitoring wells to ensure that natural attenuation is occurring and to determine when the site has reached NCWQS cleanup goals. Remedial actions associated with biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization/ destruction of the VOCs in groundwater are expected in an accelerated form of natural attenuation. Figure 5-4 identifies the existing wells that will be monitored. For cost estimating purposes, 2 years of semiannual sampling is assumed.

36GW RAA 2 also includes aquifer use restrictions to prohibit future use of the aquifers within 1,000 feet of the VOC plume. These restrictions eliminate the aquifers from being used as a potable water source. In addition, an intrusive activity boundary will also be included for the VOC plume area. These restrictions will remain in place until it can be demonstrated that the remediation cleanup goals are achieved.

Until remediation levels are met, the NCP [40 CFR 300.430(f)(4)] requires that the lead agency review the effects of this alternative at least once every five years.

5.8.5 36GW RAA 3: Monitored Natural Attenuation and Land Use Controls for Groundwater

Under 36GW RAA 3, no physical remedial actions will be conducted to reduce the toxicity, mobility, or volume of the groundwater contaminants at Site 36. Remedial actions associated with the in-situ, naturally occurring biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization / destruction of the VOCs in groundwater is expected in the form of natural attenuation. The term "natural attenuation" refers to the "naturally occurring processes in groundwater environments that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in these media" (Weidemeier 1996).

The primary component of 36GW RAA 3 is a LTM program. Over time, the results will be used to predict the type and amount of contaminant reduction that has occurred, as well as, the amount of contaminant reduction that is expected. Figure 5-5 identifies the wells that will be monitored. For cost estimating purposes, 4 years of semiannual sampling is assumed followed by 6 years of annual sampling for a total of 10 years. In an effort to provide additional evidence that natural attenuation is occurring, 36GW RAA 3 incorporates a contaminant fate and transport model.

36GW RAA 3 also includes LUCs as described in RAA 2. Until remediation levels are met, the NCP [40 CFR 300.430(f)(4)] required that the lead agency review the effects of this alternative at least once every five years.

5.9 Summary of Comparative Analysis of Alternatives

The NCP outlines the approach for comparing remedial alternatives. Evaluation of the alternatives uses “threshold”, “primary balancing”, and modifying” criteria as listed in Table 2-1. To be considered for remedy selection, an alternative must meet the two following threshold criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs and to-be-considered (TBC) criteria

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume through treatment
- Implementability
- Short-term effectiveness
- Cost

The alternatives are evaluated further against two modifying criteria:

- Acceptance by the state
- Acceptance by the community

A summary of comparative analysis of alternatives for Site 36 is provided below. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each RAA. Thus, the nine previously introduced criteria used for the detailed analysis will be the basis for the following comparative analysis.

5.9.1 Threshold Criteria

5.9.1.1 Overall Protection of Human Health and the Environment

Soil

36S RAA 1, the no action alternative, will not protect human health and the environment for the desired future land use. 36S RAA 2 is most protective of human health and the environment because it controls exposure pathways for lead contamination, the former dump, and the previous removal action areas, and accordingly protects human health, through future land use and excavation restrictions. However, no physical means will be used to protect the environment from exposure to lead contamination at Site 36.

Groundwater

36GW RAA 1, the no action alternative, will not reduce potential risks to human health and the environment. 36GW RAAs 2 and 3 both reduce potential human health risks because of the aquifer use restrictions that limit future use of the aquifers as a potable water source. 36GW RAA 2 may achieve site cleanup goals for groundwater in a shorter time frame than the other alternatives.

5.9.1.2 Compliance with ARARs

Soil

36S RAA 1, the no action alternative, does not meet the chemical-specific ARARs and remedial goals for the desired future land use. 36S RAA 2 does not meet the chemical specific ARARs but does meet location-specific and action-specific ARARs.

Groundwater

All of the RAAs, except for no action, meet the chemical-specific ARARs and remedial goals for the desired future land use. Location-specific and action-specific ARARs are met as applicable within each RAA.

5.9.2 Primary Balancing Criteria

5.9.2.1 Long-Term Effectiveness and Permanence

Soil

The no action alternative will not be effective over the long term in protecting human health and the environment because access to the lead impacted areas, former dump, and previous removal action areas will not be restricted through LUCs. 36S RAA 2 will be effective in the long term because controls are in place to protect potential receptors. LUCs for the lead contaminated areas, former dump, and previous removal action areas under 36S RAA 2 will be effective if land use restrictions are observed.

Groundwater

The effectiveness of 36GW RAAs 1, 2 and 3 depends upon how well natural attenuation reduces VOC contamination at the site. Although the time it will take for the site to reach cleanup levels is difficult to predict, 36GW RAA 2 should enhance the natural attenuation process and complete it in a shorter time frame. Also, 36GW RAAs 2 and 3 include monitoring and aquifer use restrictions to provide future protection against human exposure to contaminants groundwater at the site. 36GW RAA 1 does not provide adequate controls to protect against future exposure to groundwater at the site.

5.9.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Soil

The no action alternative will not reduce the toxicity, mobility, or volume of contaminated soil at Site 36. LUCs for the lead contaminated areas, former dump, and previous removal action areas under 36S RAA 2 will not reduce the toxicity, mobility or volume of contaminated soil, but would control exposure to lead contaminated soil, former dump, and previous removal action areas onsite.

Groundwater

36GW RAA 2 is an in-situ treatment process that will reduce the toxicity and volume of contaminants in groundwater at Site 36. The injection of HRC® into the plume is considered an active treatment. 36GW RAAs 1 and 3 involve passive treatment through natural attenuation. It is expected that the toxicity and volume of contaminants in groundwater will be reduced over time through natural attenuation.

5.9.2.3 Short-Term Effectiveness

Soil

The no action alternative is not effective for protecting human health and the environment in the short term. The contaminants will remain in place and will not be disturbed. LUCs for the lead contaminated areas, former dump, and previous removal action areas under 36S RAA 2 will be effective for protecting human health as soon as the LUCs are implemented, however, it will not be protective of the environment. It is estimated that this alternative can be implemented in less than one year.

Groundwater

The short term, effectiveness of 36GW RAA 2 will vary due to heavy equipment (drill rigs, Geoprobe®) being onsite, and the amount of time it will take to implement this RAA. Implementation of 36GW RAAs 1, 2 or 3 does not pose any substantial short-term risks to the community or workers. The specific time required for natural attenuation to reduce site contamination to cleanup goals is difficult to predict. However, it is expected that groundwater remediation under 36GW RAA 2 will take less time than 36GW RAAs 1 or 3.

5.9.2.4 Implementability

Soil

The no action alternative requires no effort because no changes will be made to effect current site conditions. LUCs for the lead contaminated areas, former dump, and previous removal action areas under 36S RAA 2 simply involves the implementation of LUCs and excavation restrictions for lead contaminated soils, the former dump, and previous removal action areas at the site. Excavation restrictions are placed on 36S RAA 2.

Groundwater

The no action alternative is the easiest to implement, as it requires no operation and maintenance, or LUCs. 36GW RAA 3, MNA, is the next most easily implemented, as it only requires periodic monitoring, which involves conventional services and equipment. 36GW RAA 2 would be the most difficult to implement and requires injection wells or direct push methods to inject the HRC® into the contaminated groundwater. 36GW RAA 2 will also require periodic monitoring.

5.9.2.5 Cost

The estimated total net present worth cost for each RAA is provided below.

Soil

36S RAA 1:	No Action	$0
36S RAA 2:	Land Use Controls for Surface and Subsurface Soil Lead Contaminated Areas, Former Dump Area, and Previous Removal Action Areas (refer to Table 5-2)	$48,352

Groundwater

36GW RAA 1:	No Action	$0
36GW RAA 2:	Enhanced Natural Attenuation and Land Use Controls for Groundwater	$691,000
36GW RAA 3:	Monitored Natural Attenuation and Land Use Controls for Groundwater (refer to Table 5-3)	$410,000

5.10 Principal Threat Wastes

The NCP established an expectation that the USEPA will use treatment to address the principal threats posed by a site whenever practicable. Principal threat wastes are those source materials

considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. There are no principal threat wastes present at OU 6.

5.11 Selected Remedy

The selected remedies for OU No. 6 are a combination of the preferred RAAs for Sites 36, 43, 44 and 54. The selected remedy for Site 36 includes:

- Site 36 - LUCs for Surface and Subsurface Soil for Lead Contaminated Areas, Former Dump Area, and Previous Removal Action Areas; LUCs for Groundwater and Monitored Natural Attenuation.

Based on available information and the current understanding of the conditions at each site, the selected remedies provide the best balance with respect to the USEPA evaluation criteria previously described.

The LUCs shall be maintained for as long as they are required to prevent unacceptable exposures to contaminated soil and groundwater or to preserve the integrity of the remedy. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

The Navy will be responsible for implementing, inspecting, reporting, and enforcing the LUCs described in this ROD in accordance with the approved LUC RD document. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. Should this LUC remedy fail, the Navy will ensure that appropriate actions are taken to reestablish its protectiveness and may initiate legal action to either compel action by a third party(ies) and/or recover the Navy's costs for remedying any discovered LUC violations.

The LUC RD document will be prepared as the LUC component of the RD. Within 120 days of ROD signature, the Navy shall prepare and submit to USEPA and NC DENR for review and approval, a LUC RD document that shall contain implementation and maintenance actions, including periodic inspections. The Navy will implement, maintain, monitor, and enforce the LUCs according to the RD.

5.11.1 Summary of the Rationale for the Selected Remedy

36S RAA 2 (LUCs for surface and subsurface for lead contaminated areas, unknown disposal materials within the former dump, and previous removal action areas) and 36GW RAA 3 (MNA and LUCs for groundwater) were selected to address contamination at Site 36 because it achieves RAOs, meets the ARARs, guards against future risk, and is cost effective. While 36GW RAA 2 (Enhanced MNA) also meets the RAOs and ARARs, it adds little benefit over 36GW RAA 3 for a substantial additional cost. The no action alternatives (36S RAA 1 and 36GW RAA 1) do not protect against future exposure to soil and groundwater, and do not meet the RAOs or ARARs. The selected remedial action identified for Site 36 is expected to meet the site-specific objectives presented in Section 5.7 that were discussed in the PRAP.

5.11.2 Remedy Description

The remedy consists of two major components: (1) LUCs for surface soil, subsurface soil, and groundwater and (2) MNA for groundwater.

Soil

Implementation of LUCs at the former dump area, areas of previous removal actions, and the lead impacted areas will preclude unrestricted use. Alternative 36S RAA 2 addresses surface and subsurface lead contamination, exposure to the unknown disposal material within the former dump and previous soil removal action areas at Site 36. Under 36S RAA 2, the LUCs for surface and subsurface soil for Lead Contaminated Areas, Former Dump and Previous Removal Action Areas addresses lead over the EPA action level of 400 ppm, and prevents exposure to the former dump and previous soil removal action areas. The LUCs will prevent exposure to potential hazards from lead contamination in surface and subsurface soils at the site. LUCs will prohibit intrusive activities and development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the former dump, lead areas, and previous soil removal action areas. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Lead contamination at Site 36 is concentrated in soils in the southeastern corner of the site. The EPA residential action level for lead in soil is 400 ppm. Therefore, any sampling location exceeding this concentration will need to be designated with LUCs. There are only three surface soil locations with a lead concentration above this action level. The majority of the lead contamination is in subsurface soils. The area of the PCB TCRA is located in the northwestern portion of the site. The former dump area is located in the eastern portion of the site, and the PAH and pesticide IRA areas are located in the central portion of the site. Figure 5-3 shows the areas to be designated with LUCs at Site 36.

Groundwater

The selected alternative for groundwater at Site 36 is 36GW RAA 3: Monitored Natural Attenuation and Land Use Controls for Groundwater. This alternative includes natural attenuation groundwater monitoring, surface water monitoring, annual groundwater modeling and LUCs for groundwater. MNA will be performed by collecting and analyzing groundwater samples to assess that no unacceptable contamination migration is occurring and to evaluate reductions in contaminant concentrations through naturally occurring processes such as biodegradation, dispersion, and dilution.

TCE, 1,1,2,2-PCA and vinyl chloride exceeded state and/or Federal standards. The vertical extent of the VOC contamination is limited to the upper portion of the Castle Hayne aquifer. This limited vertical migration appears due to the separation of the upper Castle Hayne and deeper portions of the Castle Hayne aquifer by a semi-confining unit located under Site 36.

During the FS prepared in 1998, a groundwater flow and transport model was conducted to estimate the effects of natural attenuation over time. The model indicated a 41 percent reduction of the maximum detected TCE concentration over a 30-year time period. Although this represents an estimate of contaminant fate and transport, the model indicates that allowing the groundwater to remain in-situ would most likely reduce contaminant levels via natural attenuation.

LUCs will prohibit the withdrawal and/or future use of water, except for monitoring, from the aquifers (surficial and Castle Hayne) within 1,000 feet of the identified groundwater plume. The boundary of Site 36, the estimated extent of the groundwater plume, and the area associated with the 1,000 feet aquifer use controls will include LUCs. Note that the limits of the 1,000 feet aquifer use controls are bound to the north and east by the proximity of Brinson Creek.

5.11.3 Summary of the Estimated Remedy Costs

Cost estimates for the selected soil and groundwater remedy are presented on Tables 5-2 and 5-3. The information in these cost estimates are based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost estimate are likely to occur as a result of new information and data collected. Major changes may be documented in the form of a memorandum in the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual project costs.

5.11.4 Expected Outcomes of the Selected Remedy

The current land use at Site 36 is expected to remain the same. In accordance with the LUC objectives, soil and groundwater use will be restricted to monitoring or remedial purposes. Groundwater quality will be assessed through MNA and a contaminant fate and transport model to provide evidence that MNA is occurring. If groundwater contamination has naturally attenuated to remedial cleanup goals, groundwater use restrictions may be reassessed.

6.0 SITE 43 – AGAN STREET DUMP

6.1 Site Description and History

Site 43 is comprised of approximately 11 acres and is located within the operations area of MCAS, New River, two miles west of the New River. Vehicle access to the site is via Agan Street from Curtis Road.

Figure 6-1 shows the site features for Site 43. The site is located at the northern terminus of Agan Street, adjacent to an abandoned wastewater treatment plant. The site is bordered to the north by Edwards Creek, to the east and south by Strawhorn Creek, and to the west by Agan Street and the former sewage disposal facility. Strawhorn Creek discharges into Edwards Creek at Site 43. Edwards Creek then discharges into the New River approximately 2,000 feet north of the study area, near Site 36. Much of this site is heavily vegetated with dense shrubs and trees greater than three inches in diameter. Marsh areas prone to flooding surround both the Strawhorn and Edwards Creeks. An improved gravel loop road provides access to the main portion of the study area; other, smaller unimproved paths extend outward from the gravel loop road.

The Agan Street Dump reportedly received mainly inert material such as construction debris (i.e., fiberglass and lumber) and trash. Sludge from a former sewage disposal facility, located adjacent to the study area, was also dumped at Site 43. The time period during which disposal activities occurred, however, is not known.

6.2 Previous Investigations

6.2.1 Initial Assessment Study

The IAS for Site 43 concluded that waste quantities at the site, regardless of their nature, were minor; therefore, a Confirmation Study was not recommended.

6.2.2 Site Inspection

In 1991, a Site Inspection (SI) was conducted at Site 43. The SI consisted of collecting a limited number of environmental samples (groundwater, soil, surface water, and sediment) for analysis. Contaminants detected during the SI at Site 43 included PAHs in surface soil; carbon disulfide and inorganics in groundwater; benzoic acid and inorganics in surface water; and PAHs and pesticides in sediment. Based on the findings of the SI at Site 43, an RI/FS was recommended.

6.2.3 Additional Groundwater Investigation

In 1994, an additional groundwater investigation was performed at Site 43 prior to conducting the RI to determine if vandalism of the wells had impacted groundwater or the wells themselves. The additional investigation at Site 43 included groundwater sampling of the three existing monitoring wells (43-GW01, 43-GW02, and 43-GW03). Results from the additional groundwater investigation indicated that vandalism had not impacted the usability of the existing monitoring wells at Site 43. Therefore, the wells could be employed during future groundwater sampling investigations.

6.2.4 Remedial Investigation/Feasibility Study

From February through May 1995, an RI was conducted at Site 43. The RI consisted of soil, groundwater, surface water and sediment investigation, and habitat evaluation. An FS was prepared during 2002 (Baker, 2002d) for the IRA as discussed Section 6.2.6.

6.2.5 Time Critical Removal Action

A TCRA was performed at Site 43 in 1995 based on the results of the RI. The TCRA involved the removal of surficial metallic debris, including empty drums, various scrap metals and an old tank vehicle. The Remedial Action Contractor (RAC) collected, sampled and shipped off-site four drums (1,400 lbs.) of materials for disposal.

6.2.6 Interim Removal Action

An IRA was completed at Site 43 in 2003, prior to the Final ROD. The primary focus of the IRA was the removal of PAH contaminated soil in one area located in the western portion of the site. A total of 1476.7 tons of soil was excavated during the removal action. Refer to the AM (Baker, 2002a), EE/CA (Baker, 2002c), Revised FS (Baker, 2002d), PRAP (Baker, 2002e), and the IRA Close Out Report (Shaw, 2003) for further details of the IRA.

6.3 Scope and Role of Response Actions

Documentation related to OU No. 6 as well as other IR sites, is provided in the Administrative Record. As described in Section 6.2, removal actions have occurred at Site 43 prior to the Final ROD. A TCRA was performed in 1995 for the removal of surficial metallic debris and an IRA was performed for PAHs in soil prior to the Final ROD. A Revised FS (Baker, 2002d), AM (Baker, 2002a), EE/CA (Baker, 2002c), and PRAP (Baker, 2002e) were prepared to facilitate the IRA conducted during 2003.

Previous removal actions have addressed surficial debris and PAH contamination in soil at Site 43, and fences have been installed to restrict access to the site; therefore, this ROD will address the remaining risks at Site 43. The remaining risk posed at Site 43 is related to the disposal materials that were buried at this site. Contamination identified in the surface soil at Site 43 has been excavated. Excavation into some areas at Site 43 could pose a threat through direct contact with the former site wide dump contents that will be protected through LUCs.

6.4 Site Characteristics

6.4.1 Site Overview

Site 43 is comprised of approximately 11 acres and is located within the operations area of MCAS, New River, approximately two miles west of the New River.

6.4.2 Surface and Subsurface Features

There are no USTs, ASTs, or drum storage areas within the boundary of Site 43. In addition, there are no surface structures at this site, as the site is heavily wooded.

6.4.3 Sampling Strategy

Samples collected to support the human health RA and the ecological RA for Site 43 are shown on Figure 6-1. Table B-3 summarizes the analytical results from the RI. The results of the RI are also summarized in the Final RI Report (Baker, 1996).

6.4.4 Source of Contamination

The main source of contamination at Site 43 is the solid waste placed in this former site wide dump.

6.4.5 Types of Contamination

Table B-3 presents the analytical data summary from the RI. Site 43 COCs in soil have been removed through the IRA. Accordingly, there are no remaining COCs at Site 43.

6.4.6 Location of Contamination and Routes of Migration

6.4.6.1 Lateral and Vertical Extent of Contamination

The lateral and vertical extent of contamination at Site 43 was delineated through previous investigations at this site as described in Section 6.2. Exploratory test pits and soil borings were completed during RI site activities to assess the nature and extent of any buried material within suspected disposal areas. The locations of exploratory test pits and soil borings are shown on Figure 6-1. Since the entire boundary of Site 43 is a former dump, the extent of former wastes dumped at this site is assumed to be the area of the site boundary.

6.4.6.2 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

At Site 43 the following current receptors were assessed during the human health RA for the RI: military personnel, and adult and child trespassers. Receptor exposure to surface soil, surface water, and sediment was evaluated. Groundwater was not included since Base residents obtain potable water via the Base's public water distribution system.

6.4.7 Aquifer Characteristics

Refer to Section 5.4.7.

6.5 Current and Potential Future Site and Resource Uses

6.5.1 Current Site Land Uses

Site 43 is located in a wooded area of the Base. This site area is not being used for residential activities, although Base housing areas are located adjacent to the site. Receptors at the site could include trespassers and military personnel. These receptors were considered in the human health RA.

6.5.2 Current Adjacent Site Land Uses

Site 43 is located in MCAS, New River, in the northwestern portion of MCB, Camp Lejeune. MCAS, New River includes air support activities, troop housing, and personnel support facilities that surround the aircraft operations and maintenance areas.

6.5.3 Anticipated Future Land Uses

The Base does not currently intend to build on Site 43, thereby eliminating potential exposure to the surface and subsurface soil by intrusive activities (e.g., excavations). Current land uses are anticipated to be consistent with the remedy.

6.5.4 Current Groundwater and Surface Water Uses

The MCB, Camp Lejeune Wellhead Protection Plan – 2002 (AH, 2002) was reviewed to determine the status of water supply wells near Site 43. Based on this report, there are no active potable water supply wells located within or near the boundary of Site 43. However, there are active potable water supply wells located within a one-mile radius of Site 43. Water supply wells PSWTC-600, PSWTC-1253, PSWAS-190 and PSWAS-191 are located west and southwest of Site 43. The distance of the supply wells to the site ranges from 3,600 feet to 5,400 feet and are located hydraulically upgradient of the site. Therefore, even though some of these supply wells are located within a one-mile radius of the site, it is not expected that they will be impacted by Site 43.

Shallow groundwater is not currently used as a potable source at the Base. Base residents obtain potable water via the Base's public water distribution system, which obtains the drinking water from the deeper Castle Hayne aquifer.

Site 43 is bordered to the north by Edwards Creek and to the east and south by Strawhorn Creek. Potential surface water receptors considered in the human health RA include trespassers.

6.5.5 Future Uses of Ground/Surface Water

Potential beneficial uses of groundwater and surface water are expected to be the same as the current uses identified above.

6.6 Summary of Site Risks

As part of the RI, human health and ecological RAs were conducted to determine the potential risks associated with the chemical constituents detected at Site 43 (Baker, 1996). The risks discussed below were calculated based on analytical data from the RI and do not consider the soil IRA that has occurred at Site 43 after the RI. The soil IRA performed after the RI has removed COCs in surface soil. The following subsections briefly summarize the findings of the human health and ecological RAs from the RI.

6.6.1 Human Health Risk Assessment

The human health RA estimates what risks the site poses if no remedial actions are taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarized the results of the human health RA for Site 43. Refer to the RI (Baker, 1996) for further details of the human health RA.

During the human health RA, COPCs were selected for surface soil, subsurface soil, groundwater, surface water and sediment, as shown in Table C-3.

6.6.1.1 Current Scenario

Under the current exposure scenario, military personnel and adult and child trespassers were evaluated as potential receptors, and risk values were calculated for exposure to surface soil, surface water, and sediment. Groundwater was not included since Base residents obtain potable water via the Base's public water distribution system. ILCR values did not exceed the USEPA target risk range of $1x10^{-4}$ to $1x10^{-6}$, and HI values did not exceed the target limit of 1.0, under the current exposure scenario. Thus, there are currently no unacceptable human health risks associated with the environmental media at Site 43.

6.6.1.2 Future Scenario

Under the future exposure scenario, child and adult residents were evaluated as potential receptors, and risk values were calculated for exposure to groundwater, surface soil, surface water, and sediment. In addition, a construction worker receptor was evaluated for subsurface soil exposure. None of the calculated ILCR values exceeded the USEPA target range. Thus, there are no unacceptable carcinogenic future risks associated with Site 43. There are, however, some unacceptable noncarcinogenic future risks. HI values exceeding the target limit of 1.0 were calculated for groundwater ingestion by the future child resident (HI=8.8) and the future adult resident (HI=3.8). All other HIs were below 1.0.

Iron contributed 82 percent for both elevated HI values, while aluminum contributed 18 percent. Iron appears to be a naturally occurring constituent in groundwater throughout MCB, Camp Lejeune. Iron concentrations (both total and filtered) from wells throughout the Base often exceed the state standard of 300 micrograms per liter (µg/L). Although buried construction debris is scattered throughout the site, it is not likely that iron and aluminum are leaching out of the debris. The pH of the soils and groundwater are not acidic enough to favor metals leaching. Based on this information, it appears as though iron and aluminum are naturally occurring inorganics in groundwater at the Base, and their presence is not attributable to site operations. Therefore, since iron and aluminum are naturally occurring at the Base, these inorganics do not warrant a remedial action.

6.6.2 Summary of Ecological Risk Assessment

During the ecological RA, COPCs were selected for surface water, sediment, and surface soil, as shown in Table C-4. Then, potential ecological risks associated with each COPC were evaluated. The following paragraphs summarize the conclusions made for aquatic and terrestrial receptors at Site 43. Refer to the RI (Baker, 1996) for further details of the ecological RA.

6.6.2.1 Aquatic Ecosystem

Several SVOCs, pesticides, and inorganics were detected in surface water and/or sediment at concentrations exceeding surface water screening values (SWSVs) and sediment screening values (SSVs). Based on the screening value exceedences, pesticides in the surface water and sediment may potentially affect aquatic receptors. Pesticides, however, reportedly were never stored or disposed at Site 43. Their presence is likely to be associated with Base-wide pesticide spraying that occurred in the past, rather than a site-related source of pesticide contamination. Semivolatile organic compounds (SVOCs) in the sediment and inorganics in the surface water and sediment may also potentially affect aquatic receptors. However, concentrations of SVOCs and inorganics only slightly exceeded the screening values thus indicating only a slight potential for risk. The maximum detected concentrations of copper and manganese (3.2 and 57.1 µg/L, respectively) only slightly exceeded the SWSVs (3 µg/L for copper and 10 µg/L for manganese). The maximum detected concentrations of benzo(a)pyrene, bis (2-ethylhexyl) phthalate, cadmium, copper, lead, mercury, selenium, silver, and zinc only slightly exceed their corresponding SSVs.

Based on this information, the potential ecological risks to the aquatic ecosystem are minimal and do not warrant a remedial action at Site 43.

6.6.2.2 Terrestrial Ecosystem

Several SVOCs, pesticides, and inorganics were detected in surface soil at concentrations exceeding SSSVs. Most of the SSSVs are based on one or two studies, which limits their reliability for a wide range of site-specific circumstances. Overall, the screening values have a high degree of uncertainty associated with them and are not well established. Consequently, potential risks associated with the screening values may not be completely accurate and most likely err on the conservative side.

Based on a terrestrial intake model, quotient indices (QIs) were calculated to quantify potential ecological risks for terrestrial receptors. The QIs for the bobwhite quail (1.25), the cottontail rabbit (11.7), and the raccoon (25.1) exceeded the target QI level of 1.0. Because the QIs of 1.25 and 11.7 only slightly exceed 1.0, the potential risks for these receptors appear to be insignificant. The QI of 25.1 represents a more significant exceedence of 1.0. Aluminum is the main contributor. Because the terrestrial intake model uses the conservative assumption that the raccoon will eat all of its fish from Site 43, the actual risk associated with aluminum is expected to be low. Therefore, the QI for the raccoon is likely a conservative estimate of the ecological risks that actually exist.

Based on this information, the potential ecological risks to the terrestrial ecosystem are minimal and do not warrant a remedial action at Site 43.

6.7 Remedial Action Objectives

The selected remedial actions identified for Site 43 are expected to meet the following site-specific RAOs that were developed in the FS for surface and subsurface soil. RAOs were not developed for groundwater since the human health and ecological RAs do not warrant a remedial action for groundwater.

Originally, Site 43 included a RAO for the PAH contaminated surface and subsurface soil; however, these contaminated soils were removed during the IRA performed in 2003. Refer to Section 6.2.6 for further details of the IRA for PAHs in soil. Therefore, preventing future exposure to the surface and subsurface soil within the former site wide dump from unknown disposed materials and the previous soil removal action area (i.e., PAH removal action area) will protect human health and the environment through land use restrictions on the site boundary.

6.8 Description of Alternatives

The current land use of Site 43 is anticipated to continue indefinitely. However, residential and industrial land use alternatives are considered as described in Section 5.0.

Site 43 RAAs were developed by combining the remedial action technologies and process options identified in the FS. Because Site 43 was the former Agan Street Dump, an intrusive boundary control is necessary through LUCs. Therefore, no action RAA and LUCs RAA are presented for soil. The no action RAA for groundwater was developed since groundwater does not present a risk at Site 43.

A summary table that presents a description, allowable land uses, LUCs required, and cleanup goals for each RAA is provided as Table 2-2.

Soil

43S RAA 1:	No Action	$0
43S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Former Site Wide Dump and Previous Removal Action Areas (refer to Table 6-1)	$48,352

Groundwater

43GW RAA 1:	No Action	$0

The following paragraphs briefly describe these alternatives.

6.8.1 43S RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to remove the disposal materials identified in soil at Site 43. In addition, no LUCs such as land use restrictions will be implemented at the site. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Since disposal materials will remain at Site 43 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

6.8.2 43S RAA 2: LUCs for Surface and Subsurface Soil for Former Site Wide Dump and Previous Removal Action Area

43S RAA 2 includes LUCs since the site was a former dump. Although there is no unacceptable risk through exposure to soil, it is necessary to prevent future exposure to the former site wide dump and previous soil removal action area through land use restrictions on the site boundary as requested by the Base and agreed upon by the Camp Lejeune Partnering Team. LUCs will

prohibit the development and use of property for residential housing, elementary and secondary schools, childcare facilities and recreational areas within the previous soil removal action area. LUCs will also prohibit intrusive activities within the entire site boundary. Refer to Figure 6-1 for the site boundary and previous soil removal action area that will be designated with LUCs at Site 43. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Since disposal materials will remain at Site 43 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

6.8.3 43GW RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed. In addition, no LUCs such as aquifer use restrictions or land use restrictions will be implemented at the site.

At Site 43, inorganics (particularly iron and manganese) were the most prevalent and widely distributed constituent detected. Although some samples exceeded the NCWQS, iron and manganese are naturally occurring and are often found in high concentrations throughout MCB, Camp Lejeune. It is unlikely that these inorganics are a result of previous site practices. Also, 4-methylphenol was detected at 2 µg/L in a sample from temporary monitoring well 43-TW04. This is less than the NCWQS of 3.5 µg/L. No other organic compounds were detected among groundwater samples. Therefore, groundwater at the site requires no further action.

6.9 Summary of Comparative Analysis of Alternatives

This section presents a comparative analysis of the two RAAs presented for soil for Site 43. Only one RAA is presented for groundwater, and therefore no comparative analysis will be completed for groundwater at Site 43. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each RAA. Thus, the seven previously introduced criteria used for the detailed analysis will be the basis for the following comparative analysis for soil remedial alternatives.

6.9.1 Threshold Criteria

6.9.1.1 Overall Protection of Human Health and the Environment

43S RAA 1, the no action alternative, will not protect human health and the environment for the desired future land use. Although there is no unacceptable risk through exposure to soil, it is necessary to prevent future exposure to the former site wide dump and previous removal action area through land use restrictions on the site boundary. 43S RAA 2 is most protective of human health and the environment because it controls exposure pathways to the former site wide dump area, previous removal action area, and accordingly protects human health, through future land use and excavation restrictions.

6.9.1.2 Compliance with ARARs

All soil remedial actions meet all ARARs.

6.9.2 Primary Balancing Criteria

6.9.2.1 Long-Term Effectiveness and Permanence

The no action alternative will not be effective over the long term in protecting human health and the environment because the former site wide dump area and previous removal action area will not be restricted through LUCs. 43S RAA 2 will be effective in the long term because controls are in place to protect potential receptors. LUCs for the former site wide dump area and previous removal action area under 43S RAA 2 will be effective if land use restrictions are observed.

6.9.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Soil at Site 43 does not pose a risk to receptors; however, the site is a former dump, removal actions have been performed, and LUCs are necessary to restrict access to this area and intrusive activities. Therefore, both RAAs do not require reduction of toxicity, mobility, or volume of soil treated.

6.9.2.3 Short-Term Effectiveness

The no action alternative is not effective for protecting human health and the environment in the short term. LUCs for the former site wide dump and previous removal action area under 43S RAA 2 will be effective for protecting human health as soon as the LUCs are implemented. It is estimated that this alternative can be implemented in less than one year.

6.9.2.4 Implementability

The no action alternative requires no effort because no changes will be made to affect current site conditions. LUCs for the former site wide dump and previous removal action area under 43S RAA 2 simply involves the implementation of LUCs and excavation restrictions for the entire site under 43S RAA 2.

6.9.2.5 Cost

The estimated total net present worth cost for each RAA is provided below.

Soil

43S RAA 1:	No Action	$0
43S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Former Site Wide Dump and Previous Soil Removal Action Area (refer to Table 6-1)	$48,352

Groundwater

43GW RAA 1:	No Action	$0

6.10 Principal Threat Wastes

Refer to Section 5.10.

6.11 Selected Remedy

The selected remedies for OU No. 6 are a combination of the preferred RAAs for Sites 36, 43, 44 and 54. The selected remedy for Site 43 includes:

- Site 43 - LUCs for Surface and Subsurface Soil for Former Site Wide Dump and Previous Removal Action Area.

6.11.1 Summary of the Rationale for the Selected Remedy

43S RAA 2 (LUCs for surface and subsurface soil for former site wide dump, and previous removal action area) and 43GW RAA 1 (No Action) was selected to address exposure to the unknown disposed materials at Site 43 because it achieves RAOs, meets the ARARs, guards against future risk, and is cost effective. The selected remedial action identified for Site 43 is expected to meet the site-specific objectives presented in Section 6.7 that were discussed in the PRAP.

6.11.2 Remedy Description

The remedy consists of LUCs for surface and subsurface soil.

Soil

Implementation of LUCs at the former site wide dump and area of previous removal actions at Site 43 preclude unrestricted use. There . Under 43S RAA 2, the LUCs for the Former Site Wide Dump and Previous Removal Action Area prevents exposure to the unknown disposed materials at the former site wide dump and previous soil removal action area. The site boundary and the soil removal action area are shown on Figure 6-1. LUCs will prohibit the development and use of property for residential housing, elementary and secondary schools, childcare facilities and recreational areas within the previous soil removal action area. LUCs will prohibit intrusive activities within the entire site boundary. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Groundwater

The No Action alternative is selected for groundwater at Site 43. Site 43 is a former dump and reportedly received mainly inert material such as construction debris (i.e., fiberglass and lumber) and trash. Inorganics (particularly iron and manganese) were the most prevalent and widely distributed constituents detected in groundwater. Although some samples exceeded the NCWQS, iron and manganese are naturally occurring and are often found in high concentrations throughout MCB, Camp Lejeune. It is unlikely that these inorganics are a result of previous site practices. Therefore, groundwater at the site requires no further action.

6.11.3 Summary of the Estimated Remedy Costs

Cost estimates for the selected soil remedy are presented on Table 6-1. The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative. Any major changes may be documented in the form of a memorandum in

the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual project costs.

6.11.4 Expected Outcomes of the Selected Remedy

The current land use at Site 43 is expected to remain the same. In accordance with the LUC objectives, soil will have restrictions other than for remedial purposes.

7.0 SITE 44 - JONES STREET DUMP

7.1 Site Description and History

The Jones Street Dump (Site 44) encompasses approximately 5 acres and is situated within the operations area of MCAS New River. Figure 7-1 shows the site features of Site 44. Vehicle access to the site is via Baxter Street, from Curtis Road. Site 44 is located at the northern terminus of Baxter Street, behind Base housing units situated along Jones Street. The site is partially surrounded by a six foot cyclone fence constructed in 1995 to limit access/exposure to housing residents, and a portion of the site lies to the east of the fenced area. The site is bordered to the north and west by Edwards Creek, and to the east by woods and an unnamed tributary to Edwards Creek. Edwards Creek flows east from the study area toward Site 43, which is located about 2,000 feet east of Site 44. A majority of the site is comprised of a gently dipping open field that slopes toward Edwards Creek. The field is covered with high grass, weeds, and small pine trees that are less than two inches in diameter. Surrounding the open field is a mature wooded area with a dense understory.

Site 44 was reportedly in operation during the late 1950s. Although the quantity of waste is not known, debris, cloth, lumber and paint cans were reportedly disposed at the site. It was also reported that minor quantities of potentially hazardous waste may have been disposed at Site 44; however, background information does not indicate the exact kind of hazardous waste disposed.

7.2 Previous Investigations

7.2.1 Initial Assessment Study

The IAS for Site 44 concluded that, due to the negligible quantity of inert material reportedly disposed at the site, further investigations were not warranted. After further consideration at a later date, however, Site 44 was recommended for a SI because the Base housing area is located adjacent to the site.

7.2.2 Site Inspection

In 1991, a SI was conducted at Site 44. The SI consisted of collecting a limited number of environmental samples (groundwater, soil, surface water, and sediment) for analysis. Contaminants detected during the SI at Site 44 included PAHs, pesticides, and inorganics in soil; VOCs, PAHs, and inorganics in groundwater; VOCs and inorganics in surface water; and, pesticides and inorganics in sediment. Based on the findings of the SI, an RI/FS was recommended.

7.2.3 Remedial Investigation/Feasibility Study

From February through May 1995, an RI was conducted at Site 44. The RI consisted of soil, groundwater, surface water and sediment investigation, and habitat evaluation.

7.3 Scope and Role of Response Actions

Documentation related to OU No. 6 as well as other IR sites, is provided in the Administrative Record. Fences have been installed at Site 44 to restrict access to this site. The remaining risk

posed at Site 44 is related to the disposed materials that were buried at this site. Excavation into some areas by Site 44 could pose a threat through direct contact with the former site wide dump contents that will be protected through LUCs.

7.4 Site Characteristics

7.4.1 Site Overview

Site 44 encompasses approximately 5 acres. The site is situated within the operations area of MCAS, New River and is located in the northern terminus of Baxter Street, behind Base housing units situated along Jones Street.

7.4.2 Surface and Subsurface Features

There are no USTs, ASTs, or drum storage areas within the boundary of Site 44. In addition, there are no surface structures at this site, as it is heavily wooded.

7.4.3 Sampling Strategy

Samples collected to support the human health RA and the ecological RA for Site 44 are shown on Figure 7-1. Table B-4 summarizes the analytical results from the RI. The results of the RI are also summarized in the Final RI Report (Baker, 1996).

7.4.4 Source of Contamination

The main source of contamination at Site 44 is the solid waste placed in this former site wide dump.

7.4.5 Types of Contamination

Table B-4 presents the analytical data summary from the RI. There are no COCs at Site 44.

7.4.6 Location of Contamination and Routes of Migration

7.4.6.1 Lateral and Vertical Extent of Contamination

The lateral and vertical extent of contamination at Site 44 was delineated through previous investigations at this site as described in Section 7.2. Exploratory test pits and soil borings were completed during RI site activities to assess the nature and extent of any buried material within suspected disposal areas. The locations of exploratory test pits and soil borings are shown on Figure 7-1. Since the entire boundary of Site 44 is a former dump, the extent of former wastes dumped at this site is assumed to be the area of the site boundary.

7.4.6.2 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

At Site 44 the following current receptors were assessed: military personnel, and adult and child trespassers. Receptor exposure to surface soil, surface water, and sediment was evaluated. Groundwater was not included for current residents (future residents were considered) since current Base residents obtain potable water via the Base's public water distribution system.

7.4.7 Aquifer Characteristics

Refer to Section 5.4.7.

7.5 Current and Potential Future Site and Resource Uses

7.5.1 Current Site Land Uses

Site 44 is located in a wooded area of the Base. The site area is not being used for residential activities, although Base housing areas are located adjacent to the site. Receptors at the site could include trespassers and military personnel. These receptors were considered in the human health RA.

7.5.2 Current Adjacent Site Land Uses

Site 44 is located in MCAS, New River, in the northwestern portion of MCB, Camp Lejeune. MCAS, New River includes air support activities, troop housing, and personnel support facilities that surround the aircraft operations and maintenance areas.

7.5.3 Anticipated Future Land Uses

The Base does not currently intend to build on Site 44, thereby eliminating potential exposure to the surface and subsurface soil by intrusive activities (e.g., excavations). Current land uses are anticipated to be consistent with the remedy.

7.5.4 Current Groundwater and Surface Water Uses

The MCB, Camp Lejeune Wellhead Protection Plan – 2002 (AH, 2002) was reviewed to determine the status of water supply wells near Site 44. Based on this report, the same active and inactive supply wells reported for Site 43 (Section 6.5.4) apply to Site 44.

Site 44 is bordered to the north and west by Edwards Creek, and to the east by woods and an unnamed tributary to Edwards Creek. Edwards Creek flows east from the study area toward Site 43, which is located about 2,000 feet to the east. Potential surface water receptors considered in the human health RA include trespassers.

7.5.5 Future Uses of Ground/Surface Water

Potential beneficial uses of groundwater and surface water are expected to be the same as the current uses identified above.

7.6 Summary of Site Risks

As part of the RI, human health and ecological RAs were conducted to determine the potential risks associated with the chemical constituents detected at Site 44 (Baker, 1996). The following subsections briefly summarize the findings of the human health and ecological RAs.

7.6.1 Human Health Risk Assessment

The human health RA estimates what risks the site poses if no remedial actions are taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarized the results of the human health RA for Site 44. Refer to the RI (Baker, 1996) for further details of the human health RA.

During the human health RA, COPCs were selected for surface soil, subsurface soil, groundwater, surface water, and sediment. These COPCs are shown in Table C-5.

7.6.1.1 Current Scenario

Under the current exposure scenario, military personnel and adult and child trespassers were evaluated as potential receptors, and risk values were calculated for exposure to surface soil, surface water, and sediment. Groundwater was not included since Base residents obtain potable water via the Base's public water distribution system. ILCR values did not exceed the USEPA target risk range of $1x10^{-4}$ to $1x10^{-6}$, and HI values did not exceed the target limit of 1.0, under the current exposure scenario. Thus, there are currently no unacceptable human health risks associated with the environmental media at Site 44.

7.6.1.2 Future Scenario

Under the future exposure scenario, child and adult residents were evaluated as potential receptors, and risk values were calculated for exposure to groundwater, surface soil, surface water, and sediment. In addition, a construction worker receptor was evaluated for subsurface soil exposure. All ILCR and HI values under the future scenario were within target limits with the exception of those calculated for future child and adult residents exposed to groundwater. These values include a HI of 16 and an ILCR of $1x10^{-4}$ for the future child resident, and a HI of 6.9 and an ILCR of $2x10^{-4}$ for the future adult resident.

The ILCR values of $1x10^{-4}$ (future child) and $2x10^{-4}$ (future adult) were primarily driven by the presence of vinyl chloride in groundwater. Vinyl chloride was detected, however, in only one groundwater sample at temporary well location 44-TW01, which is located approximately 50 feet from Edwards Creek. Due to the location of the well, the presence of vinyl chloride appears to be related to the VOC contamination from an upgradient source (Site 89) rather than from Site 44 since VOCs were not detected in surface soil, subsurface soil, and other groundwater samples collected at Site 44. Based on this information, it appears as though future carcinogenic risks at Site 44 are due to an upgradient source and do not warrant remedial action.

The HI values of 16 (future child) and 6.9 (future adult) were primarily driven by the presence of iron in groundwater. The iron constitutes 98 percent of both elevated risk values. However, groundwater in the MCB, Camp Lejeune area appears to be naturally rich in iron. Consequently, it is assumed that iron is a naturally occurring inorganic analyte in groundwater, and its presence is not attributable to site operations. In addition, the studies that prompted the addition of a RBC value for iron are provisional only and have not undergone formal review by the USEPA. Removing iron as a COPC, the total HI values for future residential children and adults would be 0.35 and 0.15, respectively. These values do not exceed the target limit of 1.0. Based on this information, Site 44 does not warrant remedial action.

The ILCR and HI values for future exposure to groundwater at Site 44 exceeded USEPA target limits, primarily due to iron in groundwater. However, elevated levels of iron in groundwater are naturally occurring at the Base; therefore, Site 44 groundwater does not warrant remedial action.

7.6.2 Summary of Ecological Risk Assessment

During the ecological RA, COPCs were selected for surface soil as shown in Table C-6. Then, potential ecological risks associated with each COPC were evaluated. The following paragraphs summarize the conclusions made for aquatic and terrestrial receptors at Site 44. Refer to the RI (Baker, 1996) for further details of the ecological RA.

7.6.2.1 Aquatic Receptors

No VOCs were detected at concentrations exceeding the SWSVs or SSVs; however, several SVOCs, pesticides, and inorganics were detected in the surface water and/or sediment at concentrations exceeding the SWSVs or SSVs. The ecological risks associated with SVOCs and inorganics appear to be minimal. Concentrations of inorganics in surface water and sediment, and SVOCs in sediment, only slightly exceeded the screening values or were detected infrequently. Lead was detected at low concentrations in the groundwater (maximum detection of 1.4 µg/L) and surface soil (maximum detection of 31.7 milligrams per kilogram [mg/kg]). Therefore, the lead in the surface water (maximum detection 11.2 µg/L) and sediment (maximum detection 56.3 mg/kg) does not appear to be site-related. Phenanthrene was the only SVOC in the sediment that was detected in the groundwater (7 µg/L), and none of the SVOCs in the sediment were detected in the surface soil. Therefore, it does not appear that the SVOCs in the sediment are site-related, but may be related to a nearby, upstream lift station that discharges into the unnamed tributary.

Pesticide concentrations exceeded SSVs; however, pesticides reportedly were never stored or disposed at Site 44. Their presence may be associated with Base-wide pesticide spraying that occurred in the past rather than a site-related source of pesticide contamination.

Based on this information, the potential ecological risks for the aquatic ecosystem are minimal and do not warrant remedial action at Site 44.

7.6.2.2 Terrestrial Receptors

Several SVOCs, pesticides, and inorganics were detected in the surface soil at concentrations exceeding the SSSVs. Overall, the screening values have a high degree of uncertainty associated with them and are not well established. Consequently, potential risks associated with the screening values are conservative.

In addition, the estimated CDI values for the cottontail rabbit and raccoon exceeded the TRV values. However, the COPCs causing the majority of the exceedences (aluminum, iron, and vanadium) are not related to past site activities. They are common, naturally occurring inorganics, and are not considered to be site-related.

Based on a terrestrial intake model, QIs were calculated to quantify potential ecological risks for terrestrial receptors. The QIs for the cottontail rabbit (8.54) and the raccoon (12.1) exceeded the target QI level of 1.0. Because these QIs only slightly exceed 1.0, the potential risks for these receptors appear to be insignificant.

7.7 Remedial Action Objectives

The selected remedial actions identified for Site 44 are expected to meet the following site-specific RAOs that were developed in the FS for the former site wide dump. RAOs were not developed for soil or groundwater since the human health and ecological RAs do not warrant a remedial action for these media; however, preventing future exposure to the surface and subsurface soil due to unknown disposed materials within the former site wide dump will protect human health and the environment.

7.8 Description of Alternatives

The current land use of Site 44 is anticipated to continue indefinitely. However, residential and industrial land use alternatives are considered as described in Section 5.8.

Site 44 RAAs were developed by combining the remedial action technologies and process options identified in the FS. Since soil and groundwater do not pose a site risk, and detections are below remediation goals, there is no need for further remedial action at this site; however, LUCs will be implemented in order to prevent contact with the former site wide dump as requested by the Base and agreed upon by the Camp Lejeune Partnering Team. Therefore, only the no action RAAs for soil and groundwater and LUCs for soil (entire site area) RAA are presented.

A summary table that presents a description, allowable land uses, LUCs required, and cleanup goals for each RAA is provided as Table 2-2.

Soil

44S RAA 1:	No Action	$0
44S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Former Site Wide Dump (refer to Table 7-1)	$48,352

Groundwater

44GW RAA 1:	No Action	$0

7.8.1 44S RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to remove the disposal materials identified in soil at Site 44. In addition, no LUCs such as land use restrictions will be implemented at the site. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Since disposal materials will remain at Site 44 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

7.8.2 44S RAA 2: LUCs for Surface and Subsurface Soil for Former Site Wide Dump

44S RAA 2 includes LUCs since the site was a former dump. Although there is no unacceptable risk through exposure to soil, it is necessary to prevent future exposure to the former site wide dump through land use restrictions on the site boundary as requested by the Base and agreed upon by the Camp Lejeune Partnering Team. LUCs will prohibit intrusive activities within the

entire site boundary. Refer to Figure 7-1 for the site boundary that will be designated with LUCs at Site 44. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Since disposal materials will remain at Site 44 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

7.8.3 44GW RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed. In addition, no LUCs such as aquifer use restrictions or land use restrictions will be implemented since groundwater does not pose a risk at this site and detections are below remediation goals.

7.9 Summary of Comparative Analysis of Alternatives

Only one RAA is presented for both soil and groundwater at Site 44, no action for groundwater and LUCs for soil. Therefore, a comparative analysis is not necessary for this site.

7.10 Principal Threat Wastes

Refer to Section 5.10.

7.11 Selected Remedy

The selected remedies for OU No. 6 are a combination of the preferred RAAs for Sites 36, 43, 44 and 54. The selected remedy for Site 44 includes:

- Site 44 - LUCs for Surface and Subsurface Soil for Former Site Wide Dump

7.11.1 Summary of the Rationale for the Selected Remedy

44S RAA 2 (LUCs for surface and subsurface soil for former site wide dump) and 44GW RAA 1 (No Action) was selected to address exposure to the unknown disposed materials at Site 44 because it achieves RAOs, meets the ARARs, guards against future risk, and is cost effective. The no action alternative for soil (44S RAA 1) does not protect against future exposure to the unknown disposal materials at the former site wide dump. The selected remedial action identified for Site 44 is expected to meet the site-specific objectives presented in Section 7.7 that were discussed in the PRAP.

7.11.2 Remedy Description

The remedy consists of LUCs for surface and subsurface soil.

Soil

Implementation of LUCs at the former site wide dump at Site 44 precludes unrestricted use. Under 44S RAA 2, the LUCs for the Former Site Wide Dump prevents exposure to the unknown disposed materials at the former site wide dump. The site boundary is shown on Figure 7-1. LUCs will prohibit intrusive activities within the entire site boundary. The Navy shall not

modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Soil sampling results from the RI show that inorganics are the most prevalent constituents. Because the inorganics did not generate unacceptable risk, surface soil and subsurface soil require no further active remedial action.

Groundwater

Although the quantity of waste is not known, debris, cloth, lumber and paint cans were reportedly disposed at the site. It was also reported that minor quantities of potentially hazardous waste may have been disposed at Site 44; however, background information does not indicate the exact kind of hazardous waste disposed.

No action was selected for groundwater at Site 44. There were 11 detections of VOCs and SVOCs in groundwater, however, only one exceeded the NCWQS. Temporary monitoring well 44-TW01 had a concentration of vinyl chloride of 10 µg/L, which exceeds the NCWQS of 0.015 µg/L. Vinyl chloride was not detected in any other monitoring wells onsite, only in surface water samples. This temporary well was installed in a low lying area and it is thought that contaminants migrated from the surface water, from an upgradient site, to the groundwater during periods of seasonal flooding. There were exceedences of the inorganics iron and manganese throughout the site. These inorganics are considered to be naturally occurring and not attributed to past site operations. Therefore, groundwater at the site requires no further action.

7.11.3 Summary of the Estimated Remedy Costs

Cost estimates for the selected soil remedy are presented on Table 7-1. The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative. Any major changes may be documented in the form of a memorandum in the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual project costs.

7.11.4 Expected Outcomes of the Selected Remedy

The current land use at Site 44 is expected to remain the same. In accordance with the LUC objectives, soil will have restrictions other than for remedial purposes.

8.0 SITE 54 - CRASH CREW FIRE TRAINING BURN PIT

8.1 Site Description and History

Site 54 is the former Crash Crew Fire Training Burn Pit. The site is located near the southwest end of runway 5-23, within the operations area of MCAS, New River. Figure 8-1 shows the site features of Site 54. The former burn pit was approximately 90 feet in diameter and was situated at the center of this 1.5-acre site. An 8,000-gallon UST was located to the northwest of the burn pit. Fire training exercises were conducted within the burn pit using JP-type fuel, which was stored in the nearby UST. An oil and water separator, located approximately 100 feet southeast of the burn pit, was used for temporary storage and collection of the spent fuel.

Site 54 has served as a fire training burn pit since the mid-1950s. Excess fuels, oils and solvents were used to simulate fire conditions that would result from aircraft crashes. Originally, fire training was conducted on the ground surface within a bermed area. In 1975, a concrete lined burn pit was constructed and this pit was used until 1999. Conversion of the burn pit to a training area that employs clean burning fuels with operational and engineering controls began in August 2000. In April 2001, construction and remedial activities at Site 54 were complete. The UST was removed and excavated contaminated soils from the burn pit and construction debris were taken to the Base landfill. Construction activities included a new concrete basin fire training area and two propane tanks (OHM, 2001).

8.2 Previous Investigations

8.2.1 Initial Assessment Study

The IAS for Site 54 concluded that a Confirmation Study was warranted.

8.2.2 Confirmation Study

A two-part Confirmation Study was conducted at Site 54 from 1984 through 1987. The study consisted of a Verification Step performed in 1984 and a Confirmation Step performed in 1986 and 1987. Field activities included groundwater, surface water, and sediment investigations. The Confirmation Study identified low levels of petroleum contamination in soil, groundwater, and sediment and recommended that further characterization of environmental media be implemented to complete the RI/FS process.

8.2.3 Remedial Investigation/Feasibility Study

From February through May 1995, an RI was conducted at Site 54. The RI consisted of soil, groundwater, and habitat evaluation.

The preferred remedial action for Site 54, as originally introduced in the FS in 1998, was based on the nature and extent of contamination and the potential risks to human health and/or the environment. MNA with Institutional and Engineering Controls (i.e., closing out the old burn pit and constructing a new training facility) were selected as the preferred remedial actions for Site 54. These preferred alternatives were developed to address the benzene and naphthalene detected in the surficial aquifer at concentrations exceeding Federal and state standards. In addition, the RI for Site 54 recommended completion of the operational and engineering control design requirements, including conversion of the existing burn pit to a fully lined new facility where clean fuels will be used as an accelerant. The RI also states that contaminated soils discovered during the installation of this new pit are to be removed and disposed. These actions were completed as proposed in April 2001.

During April 2001 the burn pit and associated contaminated soil were removed (refer to Section 8.2.5); therefore, a Revised FS was prepared for Site 54 in 2002. The preferred alternative for Site 54 based on the Revised FS includes groundwater monitoring of lead and LUCs. Groundwater data collected from post-RI sampling events in 2002 indicated that the VOCs, SVOCs, and lead no longer impacted the groundwater. Therefore, groundwater monitoring and aquifer use restrictions were no longer required.

8.2.4 Groundwater Monitoring Program

The post-RI groundwater monitoring program at Site 54 began in July 1998 with the quarterly collection of groundwater samples. The last round of groundwater sampling was performed in July 2002, completing 14 sampling events. Refer to Section 8.4.3 for further details of groundwater monitoring at Site 54.

8.2.5 Installation of New Fire Training Facility and Soil Removal Action

In April 2001, the RAC completed construction and remedial activities at Site 54. They removed the UST and excavated Petroleum, Oil, and Lubricant (POL) contaminated soils, and construction debris from the former burn pit. The soil excavation for Site 54 was roughly oval in shape with a length of 128 feet and a width of 96.5 feet. The excavation extended 9 feet below grade to the surface of groundwater (OHM, 2001). Construction activities included a new concrete lined fire training area and two propane tanks.

8.3 Scope and Role of Response Actions

Documentation related to OU No. 6 as well as other IR sites, is provided in the Administrative Record. As described in Section 8.2.5 the old burn pit facility and contaminated soils were removed during 2001 prior to the Final ROD. In addition, groundwater has been monitored at Site 54 and it was determined that VOCs, SVOCs, and lead no longer pose an impact to the groundwater.

8.4 Site Characteristics

8.4.1 Site Overview

Site 54 is located near the southwest end of run-way 5-23, within the operations area of MCAS, New River.

8.4.2 Surface and Subsurface Features

Site 54 is actively used as a fire training facility by the Base and contains two 1,000 gallon above ground propane storage tanks located near structure AS-3625. These propane tanks assist with the new mock fire training activities. Refer to Figure 8-1 for locations of the storage tanks at Site 54.

8.4.3 Sampling Strategy

Samples collected to support the human health RA and the ecological RA for Site 54 are shown on Figure 8-1. Table B-5 summarizes the analytical results from the RI. The results of the RI are also summarized in the Final RI Report (Baker, 1996). Results from post-RI investigations can be found in the LTM Reports (Baker, 2002b).

Table B-6 shows recent NCWQS exceedences from the monitoring program. There have been no detections of VOCs exceeding the NCWQS standards in the past 11 quarters of Post-RI groundwater monitoring. Only one SVOC, bis[2-ethylhexyl]phthalate, was detected at levels above the NCWQS of 3 μg/L in the 3 sampling rounds (July 2000, October 2000, January 2001) prior to the removal action (Baker, 2002b). In the October 2001 sampling event, three SVOCs were detected in monitoring well 54-GW11 at levels above the NCWQS. It is suspected that these detections are the result of site construction activities that impacted the integrity of the well. A Geoprobe® sample collected adjacent to this well in January 2002 verified that the SVOCs detected in October 2001 were not present in the groundwater. Lead was added to the monitoring program for one well (GW02) in April and July 2002. Based on the groundwater data collected after the removal of the burn pit, it was determined that VOCs, SVOCs, and lead no longer pose an impact to the groundwater. Subsequently, monitoring was discontinued in 2002.

8.4.4 Source of Contamination

The main source of contamination at Site 54 was the former burn pit that has been excavated.

8.4.5 Types of Contamination

Tables B-5 and B-6 present the analytical data summaries from the RI and post-RI groundwater monitoring. Site 54 COCs in soil have been removed through the burn pit removal. Accordingly, there are no remaining COCs at Site 54.

8.4.6 Location of Contamination and Routes of Migration

8.4.6.1 Lateral and Vertical Extent of Contamination

The lateral and vertical extent of contamination at Site 54 was delineated through previous investigations at this site as described in Section 8.2. Site 54 covers an area of approximately 5 acres with the area of former contamination (former burn pit) covering an area of approximately 6,000 square feet, as shown on Figure 8-1.

8.4.6.2 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

At Site 54 the following current receptors were assessed for the human health RA during the RI: military personnel and adult and child trespassers. Receptor exposure to surface soil was evaluated.

8.4.7 Aquifer Characteristics

Refer to Section 5.4.7.

8.5 Current and Potential Future Site and Resource Uses

8.5.1 Current Site Land Uses

Site 54 is actively used as a fire training facility by the Base. The site is located near the southwest end of runway 5-23. Military personnel receptors were considered in the human health RA.

8.5.2 Current Adjacent Site Land Uses

Site 54 is located in MCAS, New River, in the northwestern portion of MCB, Camp Lejeune. MCAS, New River includes air support activities, troop housing, and personnel support facilities that surround the aircraft operations and maintenance areas.

8.5.3 Anticipated Future Land Uses

The Base does not currently intend to build on Site 54, thereby eliminating potential exposure to the surface and subsurface soil by intrusive activities (e.g., excavations). Current land uses are anticipated to be consistent with the remedy.

8.5.4 Current Groundwater and Surface Water Uses

The MCB, Camp Lejeune Wellhead Protection Plan – 2002 (AH, 2002) was reviewed to determine the status of water supply wells near Site 54. Based on this report, there are no active potable water supply wells located within or near the boundary of Site 54. However, there are active potable water supply wells located within a one-mile radius of Site 54. Water supply wells

PSWAS-4150, PSWAS-5001, and PSWVL-101 are located west and southwest of Site 54. The distance of the supply wells to Site 54 range from approximately 2, 200 feet to 5,000 feet and are located hydraulically upgradient of the site and it is not expected that they will be impacted by Site 54.

There are no significant surface water features near Site 54.

8.5.5 Future Uses of Ground/Surface Water

Potential beneficial uses of groundwater are expected to be the same as the current uses identified above.

8.6 Summary of Site Risks

As part of the RI, human health and ecological RAs were conducted to determine the potential risks associated with the chemical constituents detected at Site 54 (Baker, 1996). The risks discussed below were calculated based on analytical data from the RI and do not consider the burn pit and associated contaminated soil removal action that has occurred at Site 54 after the RI. The soil removal action performed after the RI has removed COCs in surface soil. In addition, groundwater monitoring has shown that VOCs, SVOCs, and lead no longer pose an impact to the groundwater quality as discussed in Section 8.4.3. The following subsections briefly summarize the findings of the human health and ecological RAs from the RI.

8.6.1 Human Health Risk Assessment

The human health RA estimates what risks the sites pose if no remedial actions are taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarized the results of the human health RA for the sites. Refer to the RI (Baker, 1996) for further details of the human health RA.

During the human health RA, exposure to surface soil was assessed for current receptors, and exposure to subsurface soil and groundwater was assessed for future receptors. Table C-7 lists the COPCs evaluated during the human health RA.

8.6.1.1 Current Scenario

In the current case, military personnel and adult and child trespassers were assessed for exposure to surface soil. The calculated risk values (both carcinogenic and noncarcinogenic) for these receptors were within target risk levels.

8.6.1.2 Future Scenario

In the future case, child and adult residents were assessed for potential exposure to groundwater and subsurface soil. In addition, a construction worker was evaluated for subsurface soil exposure. The future risk calculated for the construction worker was within target risk levels.

The total noncarcinogenic risk and carcinogenic risk for the adult resident, however, exceeded target risk levels of 1.0 for noncarcinogenic effects and $1x10^{-4}$ for carcinogenic effects. These values were 8.3 and $1.4x10^{-4}$, respectively. The total noncarcinogenic risk for the child resident, 20, was also greater than the target risk level of 1.0. In both cases, groundwater ingestion was the main exposure route contributing to the unacceptable risks. In terms of lead effects, exposure to the maximum concentration of lead in the groundwater for a child receptor indicates the potential for adverse health effects. Iron, lead, and arsenic in groundwater contributed to these risks.

Iron was detected frequently in the site groundwater at levels exceeding the risk-based screening level. These same levels were below both Federal and state standards. In addition, groundwater in the MCB, Camp Lejeune area is naturally rich in iron. Consequently, it is assumed that iron is a naturally-occurring inorganic in groundwater, and its presence is not attributable to site operations. The toxicity values associated with exposure to this metal are based on provisional studies, which have not been verified by USEPA. In fact, if iron were removed from the evaluation of risk from groundwater ingestion, the noncarcinogenic risk for the child would decrease from 19 to 3, and for the adult from 8 to 1.2. As a result, the potential human health risk from exposure to iron in groundwater is a conservative estimate.

It is important to note that groundwater at Site 54 is not currently used as a potable water source. In addition, future residential development of the site is unlikely. Based on this information, the future groundwater exposure scenario evaluated in the human health RA, although highly protective of human health, is unlikely to occur.

8.6.2 Summary of Ecological Risk Assessment

During the ecological RA, COPCs were selected for aquatic and terrestrial receptors as shown in Table C-8 and potential ecological risks associated with each COPC were evaluated. The following paragraphs present the conclusions of the ecological RA for the aquatic and terrestrial ecosystems at Site 54.

QI is used to characterize risk for aquatic and terrestrial (ecological) receptors from exposure to contaminants in surface water and soil, sediment and biota ecological based risk.

8.6.2.1 Aquatic Receptors

Ten contaminants (xylenes, anthracene, naphthalene, aluminum, barium, cobalt, iron, lead, manganese, and nickel) in the groundwater were detected at concentrations that potentially may cause a decrease in the aquatic population if they were detected at similar concentrations in surface water. Anthracene and nickel only exceeded the SWSVs in one out of 17 wells; neither COPC exceeded the SWSV in a perimeter well. Xylenes, naphthalene, barium, and manganese while exceeding the screening values, were detected below the concentrations that are expected to cause a decrease in aquatic life using other toxicity data. Aluminum and iron are not considered to be site-related. Finally, lead exceeded the SWSVs in three wells, with the highest concentration being detected in an upgradient well. Due to the low hardness values used to calculate the SWSVs, and the expected dilution after discharging to the receiving water, the potential decrease

in the aquatic life population from lead in the groundwater is expected to be low. In addition, there is a low potential for the remaining COPCs to cause a decrease in the aquatic life population after discharging to the water bodies.

8.6.2.2 Terrestrial Receptors

Three SVOCs and three inorganics (n-nitrosodiphenylamins, phenanthrene, pyrene, aluminum, chromium, and vanadium) exceeded the SSSVs. Therefore, there is a potential for adverse impacts to terrestrial flora, invertebrates, and/or microorganisms from these contaminants. It should be noted that the habitat where these exceedences were located (mowed grass and exposed soil in the drainage ditch), along with the surrounding habitat (mowed field), are not expected to support an ecologically diverse population.

The cottontail rabbit was the only terrestrial species with estimated CDI values that exceeded the TRV values. Due to the location of the surface soil samples with the highest detections (the drainage ditch), and the relatively low QI value, it is unlikely that the contaminants in the surface soil at Site 54 will significantly reduce the rabbit population.

The ecological RA concluded that overall, some potential impacts to soil invertebrates and plants may occur as a result of site-related contaminants. It should be noted that there is much uncertainty associated with the SSSVs. A potential decrease in the terrestrial vertebrate population from site-related contaminants is not expected based on the terrestrial intake model.

8.7 Remedial Action Objectives

The selected remedial actions identified for Site 54 are expected to meet the following site-specific RAOs that were developed in the FS for the former burn pit area and former POL impacted soil. Originally, Site 54 included a RAO for the former burn pit area and contaminated surface and subsurface soil; however, the burn pit and contaminated soils were removed during 2001. Refer to Section 8.2.5 for further details of the removal action. In addition, Site 54 originally included a RAO for contaminated groundwater; however, the groundwater has been monitored through the LTM program and meets criteria as discussed in Section 8.2.4. Preventing future exposure to the surface and subsurface soil within the former burn pit area will protect human health and the environment.

8.8 Description of Alternatives

The current land use of Site 54 is anticipated to continue indefinitely. However, residential and industrial land use alternatives are considered as described in Section 5.8.
Site 54 RAAs were developed by combining the remedial action technologies and process options selected for Site 54 in the Final Revised FS. LUCs will be implemented in order to prevent residential development and intrusive activities within the former burn pit area. Although there is no unacceptable risk through exposure to soil, it is necessary to prevent future exposure to the former burn pit area through land use restrictions as requested by the Base and agreed upon by the Camp Lejeune Partnering Team.

A summary table that presents a description, allowable land uses, LUCs required, and cleanup goals for each RAA is provided as Table 2-2.

Soil

54S RAA 1:	No Action	$0
54S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Former Burn Pit Area (refer to Table 8-1)	$48,352

Groundwater

54GW RAA 1:	No Action	$0

The following paragraphs briefly describe these alternatives.

8.8.1 54S RAA 1: No Action

Under the no action RAA, no LUCs such as aquifer use restrictions or land use restrictions will be implemented at the site. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Since the former burn pit area is not being protected from future residential development under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

8.8.2 54S RAA 2: LUCs for Surface and Subsurface Soil for Former Burn Pit Area

54S RAA 2 includes LUCs for the area of the former burn pit. Although there is no unacceptable risk through exposure to soil, LUCs are placed for the area of former soil removal action for conservative measures to prevent future exposure to this area through land use restrictions. LUCs will prohibit intrusive activities and development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the area of the former burn pit. Refer to Figure 8-1 for the former burn pit area that will be designated with LUCs at Site 54. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Since the former burn pit area is being protected from future residential development under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

8.8.3 54GW RAA 1: No Action

Under the no action RAA, no LUCs such as aquifer use restrictions or land use restrictions will be implemented since groundwater does not pose a risk at this site and detections are below remediation goals.

8.9 Summary of Comparative Analysis of Alternatives

This section presents a comparative analysis of the two RAAs presented for soil at Site 54. Only one RAA is presented for groundwater, and therefore no comparative analysis will be completed for groundwater at Site 54. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each RAA. Thus, the seven previously introduced criteria used for the detailed analysis will be the basis for the following comparative analysis for soil remedial alternatives.

8.9.1 Threshold Criteria

8.9.1.1 Overall Protection of Human Health and the Environment

54S RAA 1, the no action alternative, will protect human health and the environment for the desired future land use. Although there is no unacceptable risk through exposure to soil, LUCs are placed on the area of former soil removal action for conservative measures to prevent future residential use of this area through land use restrictions. 54S RAA 2 is most protective of human health and the environment because it controls exposure pathways to the former burn pit area, and accordingly protects human health, through future land use and excavation restrictions.

8.9.1.2 Compliance with ARARs

Both RAAs meet the chemical-specific ARARs and remedial goals for the desired future land use since the soil at the former burn pit area has been cleaned to industrial levels and the groundwater meets criteria.

8.9.2 Primary Balancing Criteria

8.9.2.1 Long-Term Effectiveness and Permanence

The no action alternative will be effective over the long term in protecting human health and the environment because soil has been cleaned to industrial levels and groundwater meets criteria at Site 54; however, 54S RAA 2 will restrict intrusive activities and residential land uses in the former burn pit area. 54S RAA 2 will be effective in the long term because controls are in place to protect potential receptors. LUCs for the former burn pit area under 54S RAA 2 will be effective if land use restrictions are observed.

8.9.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Soil at Site 54 does not pose a risk to receptors; however, LUCs would restrict intrusive activities and residential land uses in the area of the former burn pit. Therefore, both RAAs do not require reduction of toxicity, mobility, or volume of soil treated.

8.9.2.3 Short-Term Effectiveness

Both alternatives are effective for protecting human health and the environment in the short term. LUCs for the former burn pit area under 54S RAA 2 will be effective for restricting intrusive activities and residential land uses as soon as the LUCs are implemented. It is estimated that this alternative can be implemented in less than one year.

8.9.2.4 Implementability

The no action alternative requires no effort because no changes will be made to affect current site conditions. LUCs for the former burn pit area under 54S RAA 2 simply involves the implementation of LUCs for excavation and residential land use restrictions. These required LUCs are easily implemented and will be maintained by the Base.

8.9.2.5 Cost

The estimated total net present worth cost for each RAA is provided below.

Soil

54S RAA 1:	No Action	$0
54S RAA 2:	Land Use Controls for Surface and Subsurface Soil for Former Burn Pit Area (refer to Table 8-1)	$48,352

Groundwater

54GW RAA 1:	No Action	$0

8.10 Principal Threat Wastes

Refer to Section 5.10.

8.11 Selected Remedy

The selected remedies for OU No. 6 are a combination of the preferred RAAs for Sites 36, 43, 44 and 54. The selected remedy for Site 54 includes:

- Site 54 - LUCs for Surface and Subsurface Soil for Former Burn Pit Area

8.11.1 Summary of the Rationale for the Selected Remedy

54S RAA 2 (LUCs for surface and subsurface soil for former burn pit area) and 54GW RAA 1 (No Action) was selected to address exposure to the former burn pit area at Site 54 because it achieves RAOs, meets the ARARs, guards against future risk, and is cost effective. The no action alternative for soil (54S RAA 1) does not protect against future residential land use and intrusive activities at the former burn pit area. The selected remedial action identified for Site 54 is expected to meet the site-specific objectives presented in Section 8.7 that were discussed in the PRAP.

8.11.2 Remedy Description

The remedy consists of LUCs for surface and subsurface soil.

Soil

Implementation of LUCs at the former burn pit area at Site 54 precludes unrestricted use. Under 54S RAA 2, the LUCs for the Former Burn Pit Area prevents exposure to the former burn pit area. The burn pit area boundary is shown on Figure 8-1. LUCs will prohibit intrusive activities and development and use of property for residential housing, elementary and secondary schools, child care facilities and recreational areas within the area of the former burn pit. The Navy shall not modify or terminate LUCs or LUC implementation actions, or cause or allow any land use inconsistent with the anticipated land use(s) identified in this ROD, without obtaining prior approval from EPA and NC DENR.

Groundwater

No action was selected for groundwater at Site 54. Based on the groundwater data collected after the removal of the burn pit, it was determined that VOCs, SVOCs, and lead no longer pose an impact to the groundwater. Therefore, groundwater at the site requires no further action.

8.11.3 Summary of the Estimated Remedy Costs

Cost estimates for the selected soil remedy are presented on Table 8-1. The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative. Any major changes may be documented in the form of a memorandum in the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual project costs.

8.11.4 Expected Outcomes of the Selected Remedy

The current land use at Site 54 is expected to remain the same. In accordance with the LUC objectives, soil will have restrictions other than for remedial purposes.

9.0 STATUATORY DETERMINATIONS

A selected remedy must satisfy requirements of CERCLA, Section 121, including: protection of human health and the environment; compliance with ARARs; cost effectiveness; utilization of permanent solutions and alternative treatment technologies or resources recovery technologies to the maximum extent practicable; and preference for treatment that reduces toxicity, mobility, or volume as a principle element (or provide an explanation as to why this preference is not satisfied). The following sections discuss how the selected remedy meets these statutory requirements.

9.1 Protection of Human Health and the Environment

The selected remedy for soil (LUCs) and groundwater (MNA with LUCs at Site 36) will protect human health and the environment. LUCs will prevent the future residential development of the sites. LUCs will also prohibit use of groundwater from the aquifers beneath Site 36. The MNA provides groundwater quality tracking and the LUCs guard against using the groundwater.

Under 36GW RAA 3, contaminants in the aquifers will remain on-site. However, these contaminants do not appear to be adversely affecting human health or the environment. Since the daughter products of TCE (1,2-DCE, vinyl chloride, and 1,1,2,2-PCA) have been detected at the site, the contamination already appears to be naturally attenuating. Also, VOCs do not appear to be migrating into Brinson Creek. Surface water sampling has not detected any VOC contamination in the creek adjacent to the site. Therefore, during the natural attenuation process, it is not expected that contaminants would migrate and cause a potential risk. Based on this information, additional physical groundwater treatment is not necessary to provide a justifiable solution for the underlying aquifers. 36GW RAA 3 ensures the protection of human health and the environment through natural attenuation, monitoring and aquifer use restrictions. Thus, 36GW RAA 3 will mitigate the potential for direct exposure, and provide overall protection of human health and the environment.

9.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy for soil (LUCs) and groundwater (MNA and LUCs at Site 36) will comply with all ARARs. The ARARs that the selected remedy complies with are presented in detail in Attachment D. Land use and groundwater use limitations will be documented. MNA will ensure compliance with ARARs. If the remedy goals are not met, additional remedial actions could be implemented in the future.

9.3 Cost Effectiveness

The selected remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” This was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria.

Overall effectiveness was evaluated by assessing balancing criteria in combination. Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs, and hence this alternative represents a reasonable value for the money to be spent.

The total estimated present worth costs of the selected remedies are $458,318 for Site 36, $48,352 for Site 43, $48,352 for Site 44, and $48,352 for Site 54, with a grand total of $603,374 for the entire OU.

MNA and LUCs provide a cost-effective remedy for groundwater at Site 36. Costs associated with the monitoring program are reasonable, and it is expected that the VOCs will naturally attenuate within 10 years (a 10 year costing period has been used). Only minimal costs associated with administrative efforts and implementation are anticipated for the LUCs. Based on the nature and extent of contamination at Site 36, the other treatment alternatives developed for groundwater would not provide significantly more protection of human health and the environment; whereas the present-worth costs estimated for these alternatives are higher than the selected alternative.

9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The Navy, MCB Camp Lejeune, USEPA, and NC DENR determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at OU 6. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy, MCB Camp Lejeune, USEPA, and NC DENR determined that the selected remedies provide the best balance in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against offsite treatment and disposal, and considering state and community acceptance.

9.5 Preference for Treatment as a Principal Element

Although the selected remedies, LUCs at Sites 36, 43, 44, and 54 and MNA at Site 36 does not provide for treatment as a principal element, reduction of soil and groundwater contamination (Site 36) concentrations are expected over time due to dispersion, advection, and adsorption processes. The selected remedies represent the maximum extent to which permanent solutions and treatment are practicable at these sites. The selected remedies provide the best balance of tradeoffs as compared to the other alternatives. In particular, the selected remedies provide a level of long-term protection cost effectively.

9.6 Five-Year Review Requirements

Because these remedies will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, the Navy will conduct a statutory remedy review consistent with the Camp Lejeune Five-Year Review to ensure that the remedy continues to provide adequate protection of human health and the environment. A Draft Five-Year Review was submitted in December 2003 and the next Five-Year Review is scheduled for December 2008.

10.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Public Meeting for OU No. 6 was held on June 18, 2002. The remedies selected as detailed in the Final PRAP were presented at the meeting. Due to the national debate between the USEPA and DoD regarding enforcement issues of the LUCs, completion of the Final ROD was pending. Accordingly, an AM was also presented at the Public Meeting for completing an IRA as an alternative plan to completing the ROD remedial actions. An EE/CA was completed in October 2002 as part of the IRAs. No significant changes were made to the preferred remedial action in the PRAP. The Final AM was also signed in December 2002. The IRAs, which included the removal of impacted soils at Sites 36 and 43, were also completed in 2003.

11.0 RESPONSIVENESS SUMMARY

In accordance with Sections 113 and 117 of CERCLA, MCB, Camp Lejeune and the Navy provided a public comment period from June 18, 2002 to July 18, 2002 for the proposed remedial actions described in the Revised FS, EE/CA, PRAP, and AM for OU No. 6 (Sites 36, 43, 44 and 54). No comments were received from the public during the comment period. The FS, EE/CA, PRAP, and AM are available to the public in the Administrative Record file at http://www.bakerenv.com/Camplejeune_irp/ and information repository maintained at the MCB, Camp Lejeune Library. A Public Meeting was held at the Coastal Carolina Community College on June 18, 2002 to present the RAAs as described in the PRAP, for OU No. 6 (Sites 36, 43, 44, and 54). The IRAs proposed for Sites 36 and 43 were also presented at the meeting per the EE/CA and AM. As discussed in this ROD, the IRAs were performed for elevated PAHs and pesticides in soil at Site 36 and PAHs in soil at Site 43. Public notice of the meeting and availability of documents was placed in the Jacksonville Daily newspaper on June 16, 2002. No comments were received outside of the Public Meeting.

11.1 Summary of Comments and Responses

The following text has been summarized from the transcripts of the Public Meeting held at the Coastal Carolina Community College on June 18, 2002. Based on comments received from the audience at the Public Meeting, the public supports the selected remedies for OU No. 6. In general, the meeting attendees asked for clarification of terms. No additional comments were made during the public comment period, which ended on July 18, 2002. The Public Meeting consisted of a presentation of OU Nos. 19 (Site 84) and 6 (Sites 36, 43, 44 and 54), and questions and answers. OU No. 6 was presented during the second half of the meeting. The actual transcript from the Public Meeting for OU No. 6 is provided as Attachment E.

The attendees of the Public Meeting included representatives from the Atlantic Division, Naval Facilities Engineering Command (LANTDIV); MCB, Camp Lejeune Environmental Quality Branch (EQB); NC DENR Superfund Section; USEPA Region IV; RAB Community Members; OHM Remediation Services (OHM/IT); CH2M Hill; and Baker Environmental, Inc. (Baker).

11.2 Background on Community Involvement

No past community interest in the contamination at Sites 36, 43, 44, and 54 has been documented.

12.0 REFERENCES

AH Environmental Consultants (AH). 2002. Wellhead Protection Plan – 2002 Update, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. August 2002.

Baker Environmental Inc. (Baker). 2003. Draft Corrective Action Plan, Operable Unit No. 6, Site 36 – Camp Geiger Area Dump, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. March 2003.

Baker Environmental, Inc. (Baker). 2002a. Final Action Memorandum for Interim Response Action Operable Unit No. 6 - Sites 36 and 43, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. December 2002.

Baker Environmental, Inc. (Baker). 2002b. Annual Monitoring Report, Operable Unit No. 6 - Sites 36 and 54, Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. October 2002.

Baker Environmental, Inc. (Baker). 2002c. Final Engineering Evaluation and Cost Analysis Operable Unit No. 6 - Sites 36, 43, 44, and 54, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. October 2002.

Baker Environmental, Inc. (Baker). 2002d. Final Revised Feasibility Study Report, Operable Unit No. 6, Sites 36, 43, 44, and 54, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. July 2002.

Baker Environmental, Inc. (Baker). 2002e. Proposed Remedial Action Plan, Operable Unit No. 6, Sites 36, 43, 44, and 54, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. June 2002.

Baker Environmental, Inc. (Baker). 2000. Temporary Well Sampling for OU No. 6 (Site 36), Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. Letter Report. July 2000.

Baker Environmental, Inc. (Baker). 1998a. Final Feasibility Study Report, Operable Unit No. 6, Site 54, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. June 1998.

Baker Environmental, Inc. (Baker). 1998b. Final Feasibility Study Report, Operable Unit No. 6, Site 36, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. June 18, 1998.

Baker Environmental, Inc. (Baker). 1996. Final Remedial Investigation Operable Unit No. 6 - Sites 36, 43, 44, and 54, Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. August 1996.

Camp Lejeune Federal Facility Agreement (FFA). FAA 1991. Federal Facilities Agreement (FFA) Between United States Environmental Protection Agency, Region IV: The North Carolina Department of Environment, Health and Natural Resources and North Carolina. North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, Raleigh, North Carolina. March 1, 1991.

Koenigsberg, Stephen S. 2000. Time-Release Electron Donor Technology For Accelerated Biological Reductive Dechlorination. Regenesis, San Clemente, CA. 2000. http://www.regenesis.com/Library/Publications/

OHM Remediation Services (OHM). 2001. Draft Contractor's Closeout Report for Sites 9 & 54. June 2001.

Shaw Environmental, Inc. (Shaw). 2003. Interim Removal Action Report Operable Unit No. 6 Site 36 and 43 Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities Engineering Command, Norfolk, Virginia. September 2003.

United States Environmental Protection Agency (USEPA). 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Documents. Office of Solid Waste and Emergency Response (OSWER) 9200.1-23P. EPA Document 540-R-98-031. July.

United States Environmental Protection Agency (USEPA). 1989. 54 Federal Register 41015. October 4, 1989.

United States Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Office of Emergency and Remedial Response, Washington, D.C., October 1988

Wiedemeier, T.H.; Swanson, M.A.; Montoux, D.E.; Gordon, E.K.; Wilson, J.T.; Wilson, B.H.; Kampbell, D.H.; Hansen, J.E.; Haas, P.; Chapelle, F.H. 1996. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. Parsons Engineering, Inc., USEPA, AFCEE Technology Transfer Division, and USGS, 1996.

TABLES

TABLE 2-1
GLOSSARY OF EVALUATION CRITERIA
OPERABLE UNIT NO. 6 – SITES 36, 43, 44 AND 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

• **Overall Protection of Human Health and the Environment** - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment engineering or institutional controls
• **Compliance with ARARs/TBCs** - addresses whether or not an alternative will meet the applicable or relevant and appropriate requirements (ARARs), criteria to-be-considered (TBCs), and other federal and state environmental statutes, and/or provide grounds for invoking a waiver.
• **Long-Term Effectiveness and Permanence** - refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.
• **Reduction of Toxicity, Mobility, or Volume Through Treatment** - refers to the anticipated performance of the treatment options that may be employed within an alternative.
• **Short-Term Effectiveness** - refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may occur during the construction and implementation period.
• **Implementability** - refers to the technical and administrative feasibility of an alternative, including the availability of materials and services required to implement the chosen solution.
• **Cost** - includes capital and operation and maintenance costs. For comparative purposes, present worth values are provided.

TABLE 2-2
SUMMARY OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT NO. 6 - SITES 36, 43, 44 AND 54
RECORD OF DECISION, CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

Alternative	Media	Description / Components	Land Use Controls Needed	Cleanup Goals
Site 36				
36S RAA 1) No Action	Soil	No remedial action or land use controls	None	NA
36S RAA 2) Land Use Controls for Surface and Subsurface Soil for Lead Contaminated Areas, Former Dump Area, and Previous Removal Action Areas	Soil	Land use controls including intrusive activity boundaries for the lead impacted soil areas, former dump area, and areas of former PCB, PAH, and Pesticide contamination that have been cleaned up to industrial standards.	Excavation Restrictions Land Use Restrictions	NA
36GW RAA 1) No Action	Groundwater	No remedial action or land use controls	None	NA
36GW RAA 2) Enhanced Natural Attenuation and Land Use Controls for Groundwater (1)	Groundwater	Injection of HRC; monitoring of progress toward cleanup goals and aquifer use restrictions	Excavation Restrictions Aquifer Use Restrictions	NCWQS (2L)
36GW RAA 3) Monitored Natural Attenuation and Land Use Controls for Groundwater (1)	Groundwater	Monitoring of natural attenuation progress toward cleanup goals and aquifer use restrictions	Excavation Restrictions Aquifer Use Restrictions	NCWQS (2L)
Site 43				
43S RAA 1) No Action	Soil	No remedial action or land use controls	None	NA
43S RAA 2) Land Use Controls for Surface and Subsurface Soil for Former Site Wide Dump and Previous Removal Action Area	Soil	Land use controls including an intrusive activity boundary for the former site-wide dump and former PAH contaminated area cleaned up to industrial standards	Excavation Restrictions Land Use Restrictions	NA
43GW RAA 1) No Action	Groundwater	No remedial action or land use controls	None	NA
Site 44				
44S RAA 1) No Action	Soil	No remedial action or land use controls	None	NA
44S RAA 2) Land Use Controls for Surface and Subsurface Soil for Former Site Wide Dump	Soil	Land use controls including a intrusive activity boundary for the former site-wide dump	Excavation Restrictions Land Use Restrictions	NA
44GW RAA 1) No Action	Groundwater	No remedial action or land use controls	None	NA
Site 54				
54S RAA 1) No Action	Soil	No remedial action or land use controls	None	NA
54S RAA 2) Land Use Controls for Surface and Subsurface Soil for Former Burn Pit Area	Soil	Land use controls including intrusive activity boundary for the former burn pit area	Excavation Restrictions Land Use Restrictions	NA
54GW RAA 1) No Action	Groundwater	No remedial action or land use controls	None	NA

(1) Land use controls in place until remedial cleanup goals are achieved

TABLE 5-1
SITE 36 FINAL GROUNDWATER COCs AND REMEDIATION GOALS
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Remedial Goal	Basis for Remedial Goal
VOLATILES (ug/L)		
Trichloroethene	2.8	NCWQS
1,1,2,2-Tetrachloroethane	0.17 (1)	NCWQS
Vinyl Chloride	0.015	NCWQS

Notes:

COC - Contaminants of Concern
NCWQS - North Carolina 2L Standard
ug/L - microgram per liter

(1) Interim Standard

TABLE 5-2
SITE 36 COST ESTIMATE SUMMARY [1] FOR THE SELECTED SOIL REMEDY
LAND USE CONTROLS FOR LEAD CONTAMINATED AREAS
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. LUCIP					
A. Plat Map	1	LS	$3,000	$3,000	Includes survey crew cost
B. Remedial Design	1	LS	$5,000	$5,000	Preparation of draft and final documents
Subtotal				$8,000	
TOTAL - DIRECT CAPITAL COSTS				**$8,000**	
ANNUAL OPERATION & MAINTENANCE COSTS					
A. 5 Year LUCIP Review	1	LS	$2,500	$2,500	Engineering Estimate
TOTAL - ANNUAL O&M COSTS				**$2,500**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$8,000	
PRESENT WORTH OF ANNUAL O&M COSTS				$40,352	
TOTAL PROJECT COST				**$48,352**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.

TABLE 5-3
SITE 36 COST ESTIMATE SUMMARY (1) FOR THE SELECTED GROUNDWATER REMEDY
MONITORED NATURAL ATTENUATION
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Base-Line Monitoring					
A. Well Installation	1	LS	$21,500	$21,500	3 Shallow wells @ $2500, 4 Intermediate wells @ $3500
B. Well Installation Oversight - Labor	1	LS	$4,500	$4,500	1 geologist @ 10 days, 10 hours/day, $45/hour
SUBTOTAL				$26,000	
TOTAL - DIRECT CAPITAL COSTS				**$26,000**	
INDIRECT CAPITAL COSTS & CONTINGENCY (2)					
I. Contingency Allowance	1	LS	$6,500	$6,500	Assume 25% of total direct capital cost
II. Design/Engineering Support	1	LS	$3,900	$3,900	Assume 15% of total direct capital cost
III. Construction Oversight	1	LS	$3,900	$3,900	Assume 15% of total direct capital cost
IIII. Legal Fees/Administration	1	LS	$3,900	$3,900	Assume 15% of total direct capital cost
V. Land Use Controls	1	LS	$5,000	$5,000	Aquifer Use Restrictions
TOTAL - INDIRECT CAPITAL COSTS				**$23,200**	
ANNUAL OPERATION & MAINTENANCE COSTS					
I. Groundwater Monitoring Program (Semi-Annual First 4 Years)					
A. Groundwater Sampling - Labor	2	event	$9,700	$19,400	2 geologists @$45/hr; 10 hrs per day; for 3 days, plus travel expenses
B. Sample Analysis	40	Ea	$300	$12,000	TCL VOC analysis, NA parameters; 14 samples plus 1 MS/MSD and 1 duplicate and trip blanks
C. Reporting	1	Ea	$20,000	$20,000	Engineering Judgement - Reporting and analysis of data
D. Well Development	5	Well	$800	$4,000	Assume each well to be developed once every 2 years
SUBTOTAL				$55,400	
E. Well Replacement	1	LS	$17,000	$17,000	2 Shallow wells @ $2500, 2 Intermediate wells @ $3500 and 1 deep well @ $5000
PRESENT WORTH OF O&M COSTS				$220,249	Present Value for First 4 Years
I. Groundwater Monitoring Program (Annual Last 6 Years)					
A. Groundwater Sampling - Labor	1	event	$9,700	$9,700	2 geologists @$45/hr; 10 hrs per day; for 3 days, plus travel expenses
B. Sample Analysis	20	Ea	$300	$6,000	TCL VOC analysis, NA parameters; 14 samples plus 1 MS/MSD and 1 duplicate and trip blanks
C. Reporting	1	Ea	$10,000	$10,000	Engineering Judgement - Reporting and analysis of data
D. Well Development	5	Well	$800	$4,000	Assume each well to be developed once every 2 years
SUBTOTAL				$29,700	
E. Well Replacement	1	LS	$14,500	$14,500	3 Shallow wells @ $2500, 2 Intermediate wells @ $3500
PRESENT WORTH OF O&M COSTS				$140,516	Present Value for Last 6 Years
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$26,000	
INDIRECT CAPITAL COSTS				$23,200	
PRESENT WORTH OF ANNUAL O&M COSTS				$360,766	Assume O&M for 10 years @ 5% discount rate
TOTAL PROJECT COST				**$409,966**	

Notes:
(1) Cost estimate to be used for budgetary information as well as for comparison of costs relative to other response action alternatives.
(2) USEPA 2000, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 540-R-00-002, OSWER 9355.0-75, July 2000

TABLE 6-1
SITE 43 COST ESTIMATE SUMMARY [1] FOR THE SELECTED SOIL REMEDY
LAND USE CONTROLS FOR SITE AREA
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. LUCIP					
A. Plat Map	1	LS	$3,000	$3,000	Includes survey crew cost
B. Remedial Design	1	LS	$5,000	$5,000	Preparation of draft and final documents
Subtotal				$8,000	
TOTAL - DIRECT CAPITAL COSTS				**$8,000**	
ANNUAL OPERATION & MAINTENANCE COSTS					
A. 5 Year LUCIP Review	1	LS	$2,500	$2,500	Engineering Estimate
TOTAL - ANNUAL O&M COSTS				**$2,500**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$8,000	
PRESENT WORTH OF ANNUAL O&M COSTS				$40,352	
TOTAL PROJECT COST				**$48,352**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.

TABLE 7-1
SITE 44 COST ESTIMATE SUMMARY [1] FOR THE SELECTED SOIL REMEDY
LAND USE CONTROLS FOR SITE AREA
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. LUCIP					
A. Plat Map	1	LS	$3,000	$3,000	Includes survey crew cost
B. Remedial Design	1	LS	$5,000	$5,000	Preparation of draft and final documents
Subtotal				$8,000	
TOTAL - DIRECT CAPITAL COSTS				**$8,000**	
ANNUAL OPERATION & MAINTENANCE COSTS					
A. 5 Year LUCIP Review	1	LS	$2,500	$2,500	Engineering Estimate
TOTAL - ANNUAL O&M COSTS				**$2,500**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$8,000	
PRESENT WORTH OF ANNUAL O&M COSTS				$40,352	
TOTAL PROJECT COST				**$48,352**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.

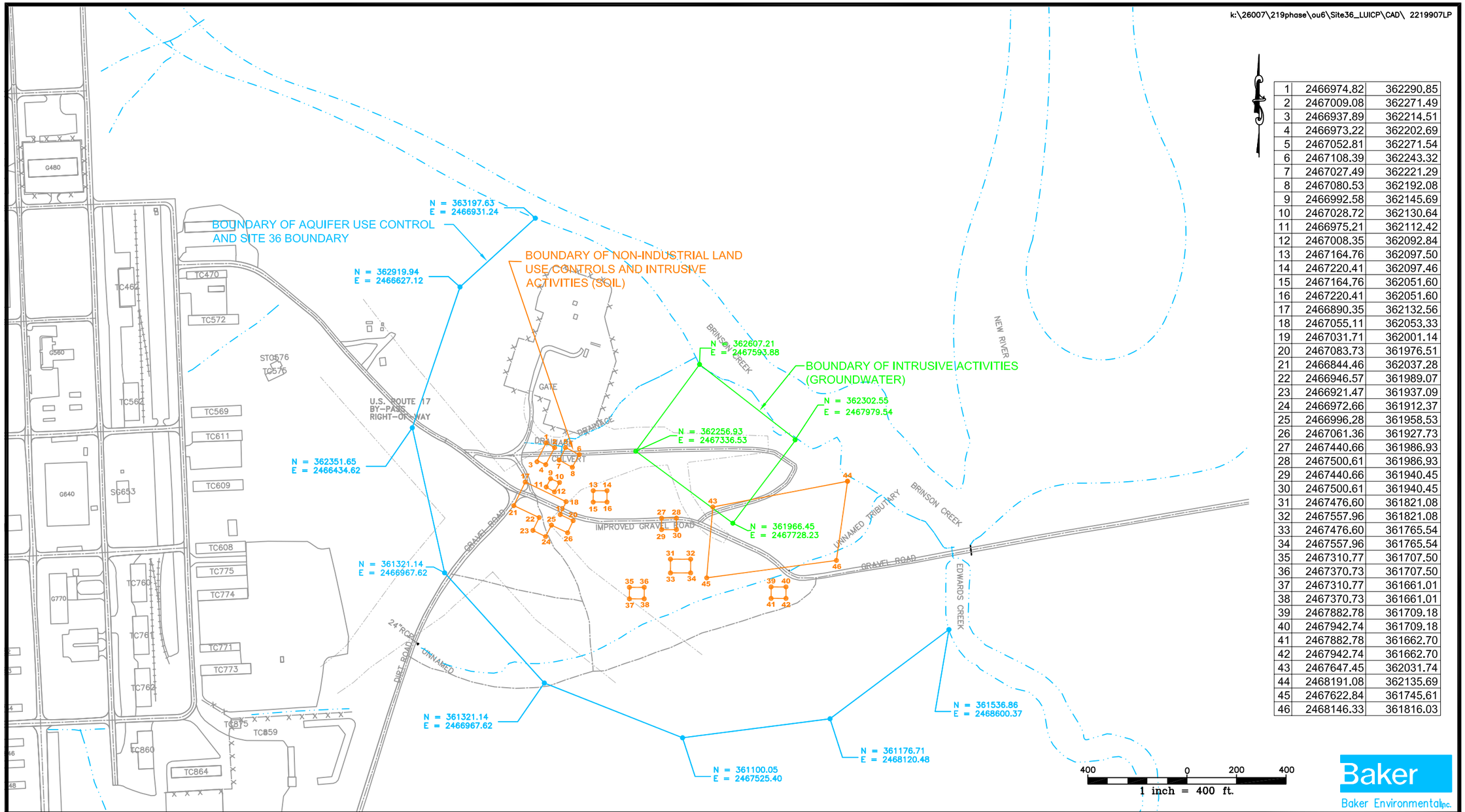
TABLE 8-1
SITE 54 COST ESTIMATE SUMMARY [(1)] FOR THE SELECTED SOIL REMEDY
LAND USE CONTROLS FOR FORMER BURN PIT AREA
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. LUCIP					
A. Plat Map	1	LS	$3,000	$3,000	Includes survey crew cost
B. Remedial Design	1	LS	$5,000	$5,000	Preparation of draft and final documents
Subtotal				$8,000	
TOTAL - DIRECT CAPITAL COSTS				**$8,000**	
ANNUAL OPERATION & MAINTENANCE COSTS					
A. 5 Year LUCIP Review	1	LS	$2,500	$2,500	Engineering Estimate
TOTAL - ANNUAL O&M COSTS				**$2,500**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$8,000	
PRESENT WORTH OF ANNUAL O&M COSTS				$40,352	
TOTAL PROJECT COST				**$48,352**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.

FIGURES

k:\26007\219phase\ou6\Site36_LUICP\CAD\ 2219907LP



1	2466974.82	362290.85
2	2467009.08	362271.49
3	2466937.89	362214.51
4	2466973.22	362202.69
5	2467052.81	362271.54
6	2467108.39	362243.32
7	2467027.49	362221.29
8	2467080.53	362192.08
9	2466992.58	362145.69
10	2467028.72	362130.64
11	2466975.21	362112.42
12	2467008.35	362092.84
13	2467164.76	362097.50
14	2467220.41	362097.46
15	2467164.76	362051.60
16	2467220.41	362051.60
17	2466890.35	362132.56
18	2467055.11	362053.33
19	2467031.71	362001.14
20	2467083.73	361976.51
21	2466844.46	362037.28
22	2466946.57	361989.07
23	2466921.47	361937.09
24	2466972.66	361912.37
25	2466996.28	361958.53
26	2467061.36	361927.73
27	2467440.66	361986.93
28	2467500.61	361986.93
29	2467440.66	361940.45
30	2467500.61	361940.45
31	2467476.60	361821.08
32	2467557.96	361821.08
33	2467476.60	361765.54
34	2467557.96	361765.54
35	2467310.77	361707.50
36	2467370.73	361707.50
37	2467310.77	361661.01
38	2467370.73	361661.01
39	2467882.78	361709.18
40	2467942.74	361709.18
41	2467882.78	361662.70
42	2467942.74	361662.70
43	2467647.45	362031.74
44	2468191.08	362135.69
45	2467622.84	361745.61
46	2468146.33	361816.03

LEGEND:

- BOUNDARY OF AQUIFER USE CONTROL
- BOUNDARY OF INTRUSIVE ACTIVITIES (GROUNDWATER)
- BOUNDARY OF NON-INDUSTRIAL LAND USE CONTROLS AND INTRUSIVE ACTIVITIES (SOIL)

SOURCE: MCB, CAMP LEJEUNE MARCH 2000

Baker
Baker Environmental Inc.

FIGURE 1-1
BOUNDARY OF LAND USE CONTROLS
RECORD OF DECISION
OPERABLE UNIT NO. 6
SITE 36, CAMP GEIGER AREA DUMP
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\OU6\LUCIP-Site 36\cad\2219908LP

EDWARDS CREEK

FLOW

N = 360222.95
E = 2469358.69

FLOW

STRAWHORN CREEK

DRAINAGE DITCH

N = 360156.86
E = 2469101.38

N = 360046.30
E = 2469005.70

N = 360001.80
E = 2469585.45

BOUNDARY OF INTRUSIVE ACTIVITIES (SOIL)
AND SITE 43 BOUNDARY
576136.20 sqft.
13.22621 Acres

N = 359815.16
E = 2468903.16

N = 359815.16
E = 2468985.91

SOIL PATH

N = 359795.90
E = 2468848.55

BOUNDARY OF NON-INDUSTRIAL
LAND USE CONTROL (SOIL)

MARSH

N = 359739.45
E = 2468985.91

N = 359738.40
E = 2469536.65

FLOW

GRAVEL ROAD

N = 359739.45
E = 2468903.16

N = 359656.15
E = 2468814.91

AGAN STREET

DRAINAGE DITCH

STRAWHORN CREEK

N = 359501.25
E = 2469462.80

SA5629

GRAVEL ROAD

N = 359425.40
E = 2468798.56

SOIL PATH

MARSH

36"RCP

N = 359265.20
E = 2468830.65

FLOW

STRAWHORN CREEK

N = 359244.70
E = 2469288.80

N = 359179.45
E = 2468944.75

STRAWHORN CREEK

N = 359202.40
E = 2469137.20

FLOW

AGAN STREET

1212

AS604

LEGEND

BOUNDARY OF INTRUSIVE ACTIVITIES

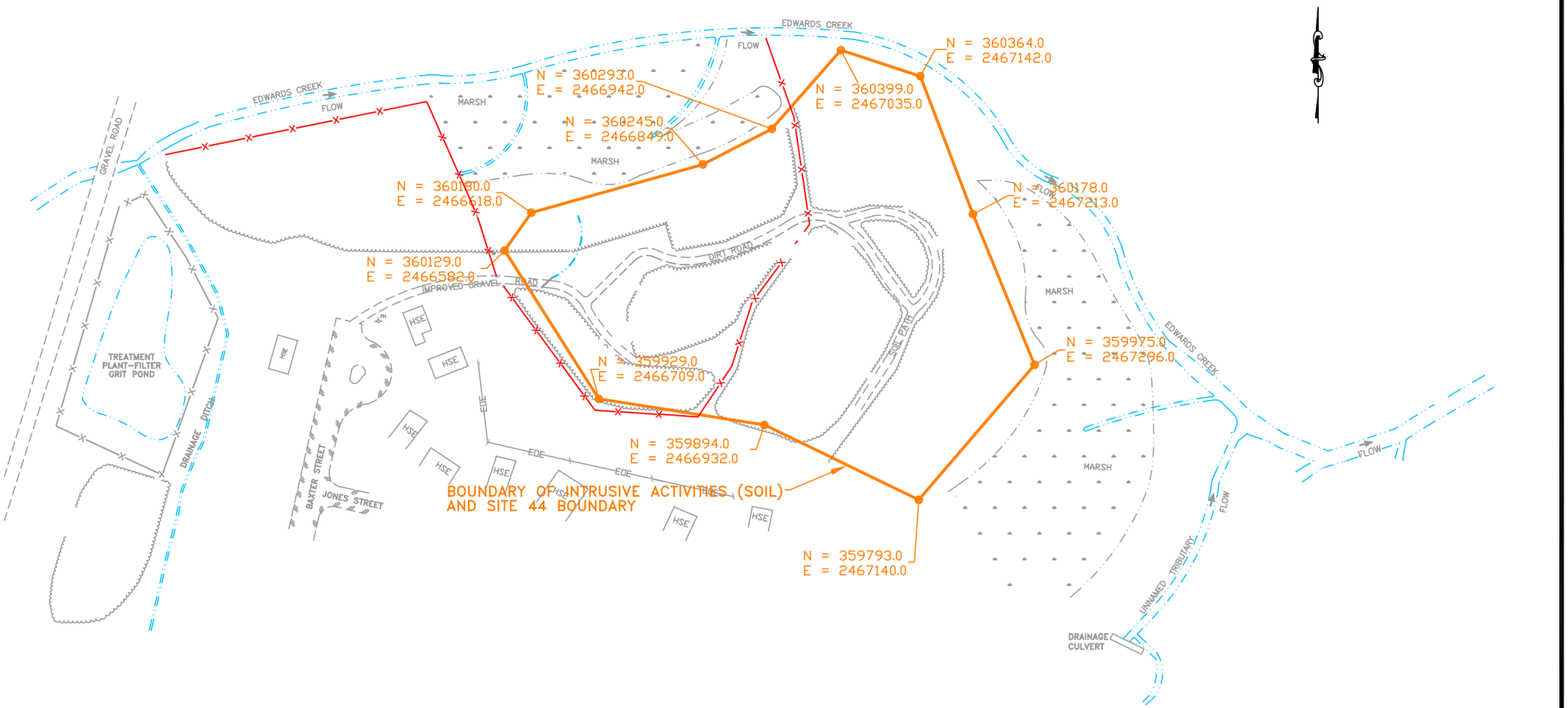
120 0 60 120
1 inch = 120 ft.

Baker

SOURCE: MCB, CAMP LEJEUNE MARCH 2000

FIGURE 1-2
BOUNDARY OF LAND USE CONTROLS
RECORD OF DECISION
OPERABLE UNIT NO.6
SITE 43, AGAN STREET DUMP
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\OU6\LUCIP-Site 36\cad\2219909LP



Baker
Baker Environmental, Inc.

LEGEND

BOUNDARY OF INTRUSIVE ACTIVITIES

SITE ACCESS CONTROL (FENCE)

SOURCE: MCB, CAMP LEJEUNE, MARCH 2000

FIGURE 1-3
BOUNDARY OF LAND USE CONTROLS
RECORD OF DECISION
OPERABLE UNIT NO.6
SITE 44, JONES STREET DUMP
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\0U6\LUCIP-Site 36\cad\2219910LP

ASPHALT ROAD

BOUNDARY OF NON-INDUSTRIAL
LAND USE CONTROLS AND
INTRUSIVE ACTIVITIES (SOIL)

N = 351139.5017
E = 2465506.8934

N = 351139.5017
E = 2465579.3054

N = 351113.0863
E = 2465467.2392

N = 351119.4031
E = 2465609.1897

SAS3614

N = 351066.5723
E = 2465467.2392

N = 351078.0572
E = 2465609.1897

N = 351029.8204
E = 2465507.1807

N = 351029.8204
E = 2465558.9036

S3625

50 0 25 50
1 inch = 50 ft.

Baker

LEGEND

BOUNDARY OF NON-INDUSTRIAL LAND USE CONTROLS AND INTRUSIVE ACTIVITIES (SOIL)

SOURCE: MCB CAMP LEJEUNE, MARCH 2000

FIGURE 1-4
BOUNDARY OF LAND USE CONTROLS
RECORD OF DECISION
OPERABLE UNIT No. 6
SITE 54, CRASH CREW FIRE TRAINING BURN PIT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

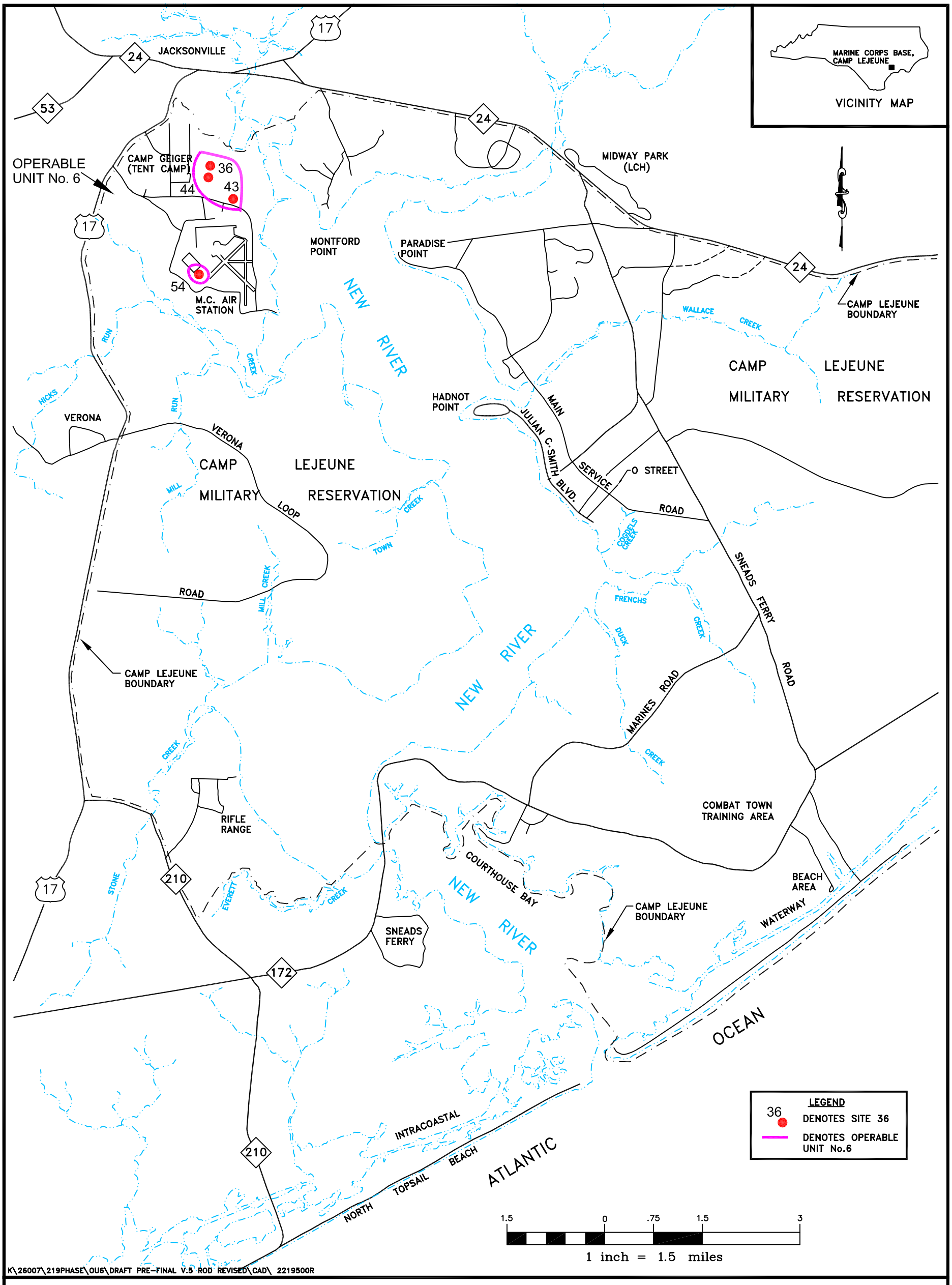


FIGURE 2-1
SITE LOCATION MAP
RECORD OF DECISION,
OPERABLE UNIT No. 6 - SITES 36, 43, 44 AND 54
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219502R

U.S. ROUTE 17
BY-PASS
RIGHT-OF-WAY

APPROXIMATE
SITE BOUNDARY

BRINSON CREEK

NEW RIVER

UNNAMED TRIBUTARY

GRAVEL ROAD

IMPROVED GRAVEL ROAD

DRAINAGE

CULVERT

GATE

EDWARDS CREEK

NOTE:
THE FOLLOWING WELLS HAVE BEEN ABANDONED: 36-GW04, 36-GW06, 36-GW06DW, 36-GW08, 36-GW12, 36-GW12IW, 36-GW14, 36-GW15, AND 36-GW17,
SOURCE: LANTDIV, MARCH 2000

250 0 125 250
1 inch = 250 ft.

Baker

LEGEND

- FLOW — DIRECTION OF SURFACE WATER FLOW
- FENCE
- TP01 — EXPLORATORY TEST PIT LOCATION
- GRAVEL ROAD
- EDGE OF DRAINAGE DITCH
- US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
- SG01 — STAFF GAUGE
- OA-SB02 — SOIL BORING LOCATION
- 36-SW/SD01 — SURFACE WATER AND SEDIMENT SAMPLE LOCATION
- 36-SW/SD05 / 36-BN05 — SURFACE WATER, SEDIMENT AND BENTHIC SAMPLE LOCATION
- 36-GW14 — SHALLOW MONITORING WELL
- 36-GW12IW — INTERMEDIATE MONITORING WELL
- 36-GW06DW — DEEP MONITORING WELL
- 36-TW01 — TEMPORARY MONITORING WELL

FIGURE 5-1
REMEDIAL INVESTIGATION SAMPLING LOCATIONS RECORD OF DECISION, OPERABLE UNIT NO. 6 SITE 36, CAMP GEIGER DUMP AREA CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

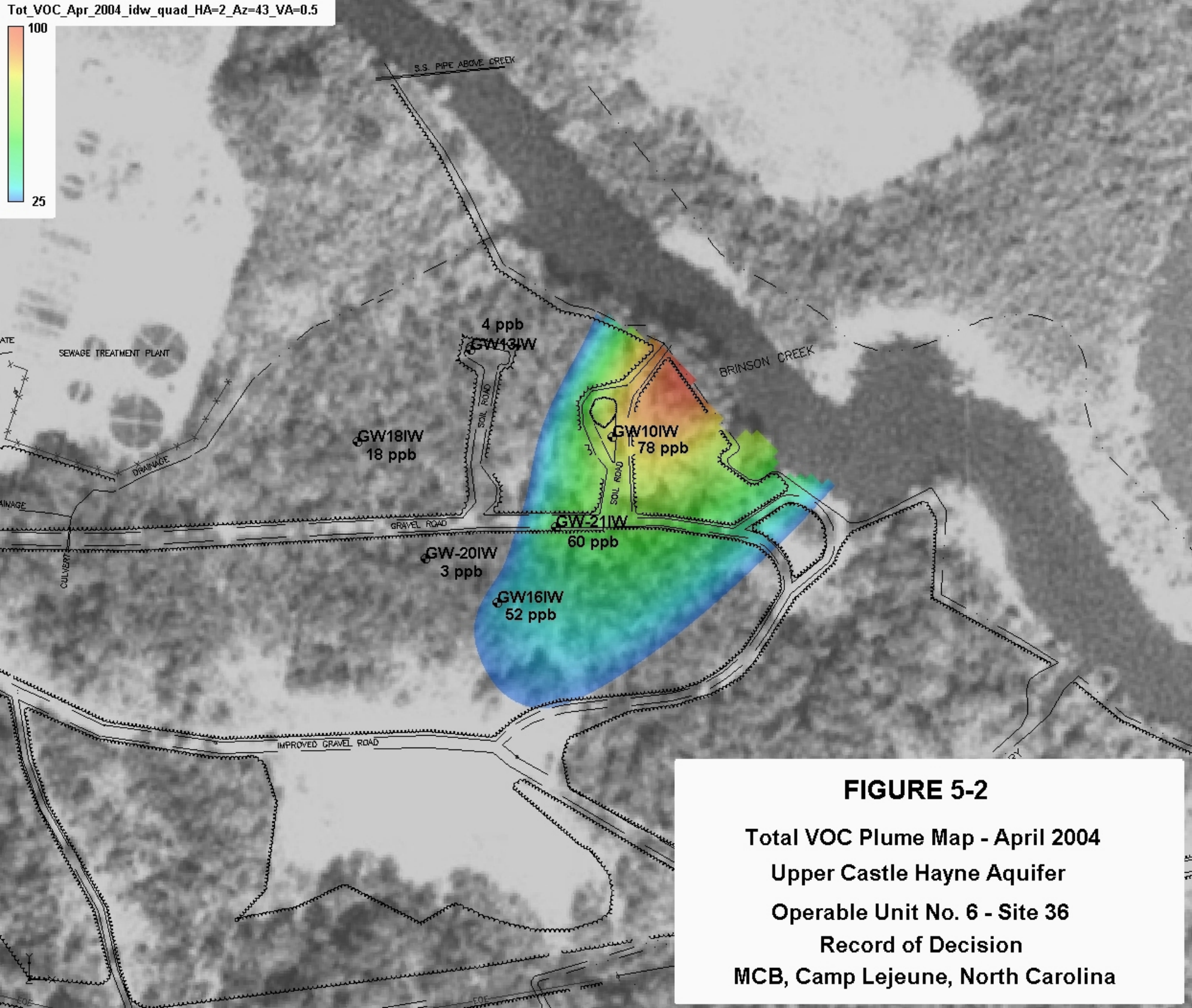


FIGURE 5-2

Total VOC Plume Map - April 2004

Upper Castle Hayne Aquifer

Operable Unit No. 6 - Site 36

Record of Decision

MCB, Camp Lejeune, North Carolina

K\26007\219PHASE\OU6\DRAFT PRE-FINAL DRAFT ROD REVISED\CAD\ 2219503R

U.S. ROUTE 17
BY-PASS
RIGHT-OF-WAY

GATE

EOE

DRAINAGE

CULVERT

APPROXIMATE
SITE BOUNDARY

IMPROVED GRAVEL ROAD

GRAVEL ROAD

UNNAMED TRIBUTARY

FLOW

36-GW13IW 36-GW13 GS-SB04 GS-SB03
GS-SB02 GS-SB01
36-GW10IW GS-SB05 36-GW10DW
36-GW10 ND 10 (5-7') GS-SB06
36-GW12IW 36-GW12
36-GW03
OA-SB06 35.6J 112 (3-5')
OA-SB01 30.2 (1-3')
OA-SB01B 13 (1-3')
OA-SB04 477J 1.4 (3-5')
OF-SB01 4.5 3.3 (7-9')
OF-SB03 41 5.1 (5-7')
OA-SB03 7.1 209J (5-7')
TP06A TP06B
36-GW09 ND 151 (7-9')
OF-SB02 69 2.1J (3-5')
OF-SB04 234 17.4 (7-9')
TP07
OA-SB05 116 2.8 (3-5')
FCA-SB14 3.9 (1-3')
OF-SB06A ND 871 (1-3')
OF-SB06D 18.1 555 (3-5')
OF-SB06C
TP01 TP02
OF-SB06 21.7 11.2 (5-7')
OF-SB06B 1210 (3-5')
OA-SB07R
36-GW01
FDA-SB01 67.1J 453J (3-5')
FDA-SB02 23.7 190J (7-9')
FDA-SB03 14.5 1.2 (7-9')
TP04 TP03 TP05
36-GW11 35.3 1980 (7-9') 5.4 (11-13')
36-GW11DW
FDA-SB04 8.3 33.8J (1-3')
FDA-SB05 14.5 424J (1-3')
OA-SB07 299J 2680J (1-3')
36-GW02
FDA-SB06 51.9J 143J (13-15')
OA-SB08 836J 7.7 (1-3')
SB04 SB01 SB02 SB03
519 (1-3')
36-GW08
DAD-SB01 111J
DAD-SB03 222J
DAD-SB02 86.3J 60.1J (1-3')
DAB-SB03 91.9J 37.6J (1-3')
DAB-SB01 71.3J 158J (1-3')
DAB-SB02 33.4J 82.8J (3-5')
86.7 (0-6") 23.4 (6-12")

36-GW14 SHALLOW MONITORING WELL
36-GW12IW INTERMEDIATE MONITORING WELL
36-GW06DW DEEP MONITORING WELL
OA-SB02 SOIL BORING LOCATION
36-SB01 BORING FROM JANUARY 2001
TP01 EXPLORATORY TEST PIT LOCATION
SURFACE CONCENTRATION mg/kg
400 SURFACE CONCENTRATION EXCEEDING THE 400 MAX FEDERAL LEVEL mg/kg (OSWER VALUE)
SUBSURFACE CONCENTRATION (SAMPLE DEPTH) mg/kg
1980 (7-9') SUBSURFACE CONCENTRATION (SAMPLE DEPTH) EXCEEDING THE 400 MAX FEDERAL LEVEL mg/kg (OSWER VALUE)

150 0 75 150
1 inch = 150 ft.

Baker

LEGEND

FLOW DIRECTION OF SURFACE WATER FLOW
GRAVEL ROAD
EDGE OF DRAINAGE DITCH
BOUNDARY OF PREVIOUS PCB SOIL REMOVAL ACTION
US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
LUC BOUNDARY FOR LEAD

SOURCE: LANTDIV, MARCH 2000

FIGURE 5-3
36S RAA 2 : LAND USE CONTROL BOUNDARIES FOR SURFACE AND SUBSURFACE SOIL FOR LEAD CONTAMINATED AREAS, FORMER DISPOSAL AREA, AND PREVIOUS REMOVAL ACTION AREAS
RECORD OF DECISION, OPERABLE UNIT NO. 6
SITE 36, CAMP GEIGER DUMP AREA
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219504R

36-SW01 (1000 FEET UPSTREAM)

36-SW02

BRINSON CREEK

FLOW

36-GW13IW

36-GW13

36-GW18IW

36-GW18

36-GW10

36-GW10IW

36-GW10DW

36-SW03

GATE

EOE

DRAINAGE

CULVERT

36-GW20IW

36-GW21IW

36-GW16IW

36-GW19

36-GW03

APPROXIMATE SITE BOUNDARY

ESTIMATED EXTENT OF PLUME

BRINSON CREEK

36-SW04

IMPROVED GRAVEL ROAD

36-GW11

36-GW11DW

36-GW09

36-GW02

UNNAMED TRIBUTARY

GRAVEL ROAD

36-GW01

36-GW07

36-GW07DW

24"RCP

DIRT ROAD

UNNAMED TRIBUTARY

36-GW05

TC572

TC576

TC575

TC569

TC611

TC609

TC608

TC775

TC774

TC771

TC773

U.S. ROUTE 17
BY-PASS
RIGHT-OF-WAY

NOTE
WELLS AND SURFACEWATER LOCATIONS SHOWN IN RED ARE TO BE INCLUDED IN THE MONITORING PROGRAM.

200 0 100 200
1 inch = 200 ft.

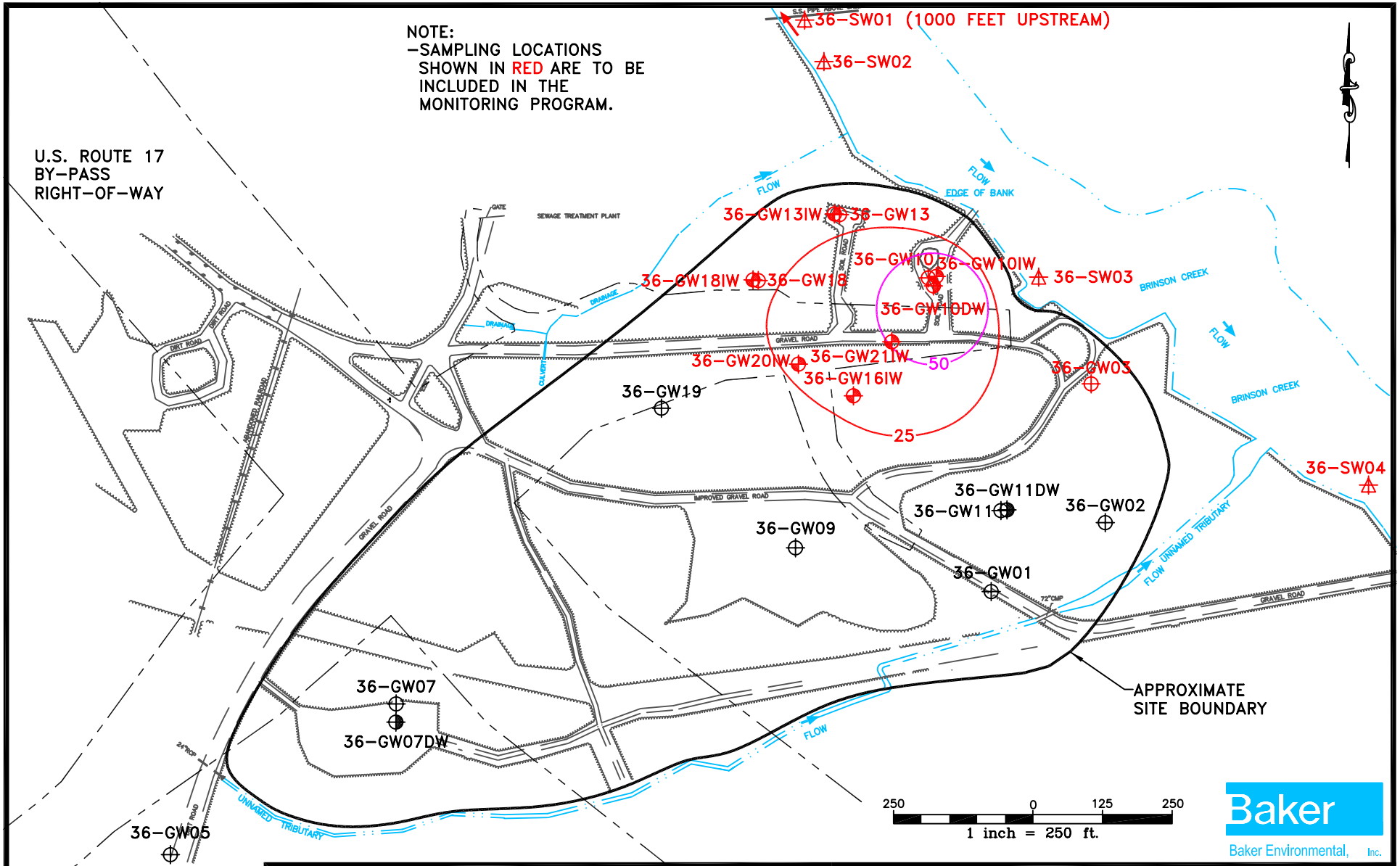
Baker
Baker Environmental, Inc.

LEGEND:

- 36-GW02 — SHALLOW MONITORING WELL
- 36-GW10IW — INTERMEDIATE MONITORING WELL
- 36-GW10DW — DEEP MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- DIRECTION OF GROUNDWATER FLOW IN THE VICINITY OF THE VOC AREA OF CONCERN
- FLOW — DIRECTION OF SURFACE WATER FLOW
- GRAVEL ROAD
- EDGE OF CREEK, RIVER, OR DRAINAGE
- US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
- HRC INJECTION GRID

SOURCE: LANTDIV, MARCH 2000

FIGURE 5-4
36GW RAA 2: ENHANCED NATURAL ATTENUATION (HRC)
RECORD OF DECISION, OPERABLE UNIT NO. 6
SITE 36, CAMP GEIGER AREA DUMP
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- 36-GW01 – SHALLOW MONITORING WELL
- 36-GW10IW – INTERMEDIATE MONITORING WELL
- 36-GW10DW – DEEP MONITORING WELL
- SURFACE WATER SAMPLE
- 50 – TOTAL VOC ISOCONCENTRATION CONTOUR (ug/L)

K\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219505R

FIGURE 5-5
36GW RAA 3: MONITORED NATURAL ATTENUATION
RECORD OF DECISION, OPERABLE UNIT No. 6
SITE 36, CAMP GIEGER AREA DUMP
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219507R

APPROXIMATE SITE BOUNDARY

ABANDONED SEWAGE DISPOSAL FACILITY

EC-SW/SD01
EC-SW/SD02
SHC-SW/SD01
SHC-SW/SD02
SHC-SW/SD03
SHC-SW/SD04

43-GW01
43-GW01DW
43-GW02
43-GW03
43-GW04
43-GW04DW

43-TW01
43-TW02
43-TW03
43-TW04

43-PZ01

43-TP01
43-TP02
43-TP03
43-TP04
43-TP05

OA-SB01
OA-SB02
OA-SB03
OA-SB04
OA-SB05
OA-SB06
OA-SB07

DA1-SB01
DA1-SB02
DA1-SB03

DA2-SB01
DA2-SB02

WA-SB01
WA-SB02
WA-SB03

MA-SB01
MA-SB02
MA-SB03
MA-SB04
MA-SB05

BB-SB01
BB-SB02
BB-SB03

FLOW
STRAWHORN CREEK
DRAINAGE DITCH
MARSH
SOIL PATH
GRAVEL ROAD
AGAN STREET
SEWAGE PUMP/LIFT STATION
DAYCARE/ MINISCHOOL
36"RCP
12"RCP

LEGEND

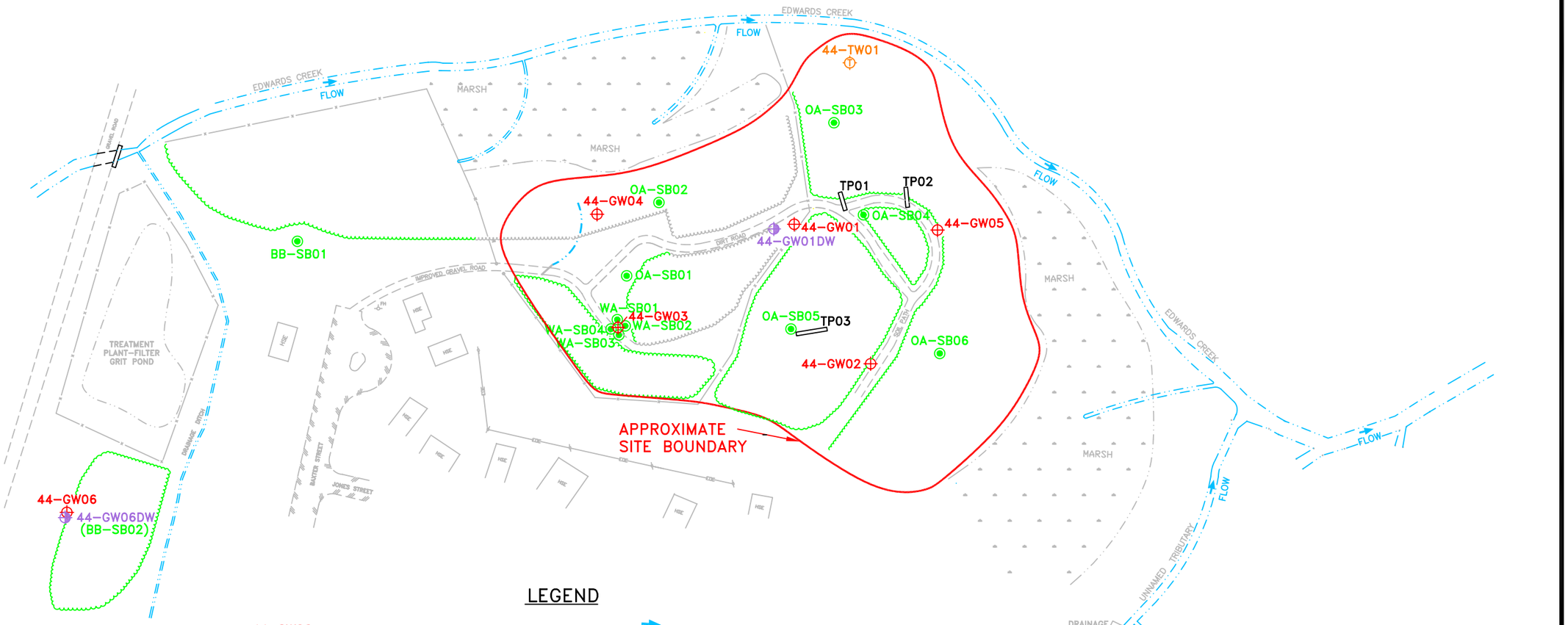
- 43-GW01 — SHALLOW MONITORING WELL
- 43-GW01DW — DEEP MONITORING WELL
- 43-TW01 — TEMPORARY MONITORING WELL
- 43-PZ01 — PIEZOMETER
- OA-SB01 — SOIL BORING LOCATION
- SHC-SW/SD01 — SURFACE WATER AND SEDIMENT SAMPLING LOCATION
- 43-TP01 — TEST PIT LOCATION
- FLOW — DIRECTION OF SURFACE WATER FLOW
- MARSH
- EOE — OVERHEAD ELECTRIC LINE & UTILITY POLE
- FENCE
- ASPHALT ROAD
- GRAVEL ROAD OR SOIL PATH
- EDGE OF CREEK, DRAINAGE DITCH OR MARSH
- TREE LINE
- STRUCTURE

120 0 60 120
1 inch = 120 ft.

Baker
Baker Environmental, Inc.

FIGURE 6-1
REMEDIAL INVESTIGATION SAMPLING LOCATIONS
RECORD OF DECISION, OPERABLE UNIT NO. 6
SITE 43, AGAN STREET DUMP
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219509R



LEGEND

44-GW06	SHALLOW MONITORING WELL
44-GW06DW	DEEP MONITORING WELL
OA-SB02	SOIL BORING LOCATION
44-TW01	TEMPORARY MONITORING WELL
TP01	EXPLORATORY TEST PIT
FLOW	DIRECTION OF SURFACE WATER FLOW
	MARSH
EOE	OVERHEAD ELECTRIC LINE & UTILITY POLE
	FENCE
	ASPHALT ROAD
	GRAVEL OR DIRT ROAD
	EDGE OF CREEK, DRAINAGE DITCH, MARSH OR POND
	TREE LINE
HSE	BASE HOUSING UNIT

Baker

Baker Environmental, Inc.

FIGURE 7-1
REMEDIAL INVESTIGATION SAMPLING LOCATIONS
RECORD OF DECISION, OPERABLE UNIT NO. 6
SITE 44, JONES STREET DUMP
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K:\26007\219PHASE\OU6\DRAFT PRE-FINAL V.5 ROD REVISED\CAD\ 2219511R

54-GW02
54-GW12
54-GW07
ES07
ES09
SB01
NEW BURN PIT
SB07
SB06
ES08
TW01
APPROXIMATE SITE BOUNDARY
ES05
TW06
ES06
TW05
TW07
TW04
FORMER BURN PIT
SB02
ES10
ES13
ES12
SB05
TW03
54-GW10
54-GW06
ES11
CONCRETE PAD
54-GW08
ES16
TW02
ES15
54-GW01
ES14
54-GW11
SB03
54-GW09
54-GW05
ES17
ES18
SB08
ES01
ES02
ES04
ES03
SB09
SB04
54-GW04
54-GW13
DD-SB01
DD-SB02
DD-SB03
DD-SB04
DITCH
DITCH
DRAINAGE SWALE
DD-SB05
54-GW03
NOTE: MONITORING WELLS 54-GW11, 54-GW12, AND 54-GW13 WERE INSTALLED DURING THE POST-RI FIELD INVESTIGATION.
ASPHALT ROAD
PERIMETER ROAD
GRAVEL ROAD
GRAVEL ROAD
FLOW
AS3625
AS3614

100 0 50 100
1 inch = 100 ft.

Baker
Baker Environmental, Inc.

LEGEND

- 54-GW07 — SHALLOW MONITORING WELL
- TW01 — TEMPORARY MONITORING WELL
- SB09 — SOIL BORING LOCATION
- ES09 — IMMUNOASSAY FIELD SCREENING SOIL BORING
- FLOW — DIRECTION OF SURFACE WATER FLOW
- MARSH
- FENCE
- ASPHALT ROAD OR AREA
- GRAVEL ROAD
- EDGE OF CREEK OR MARSH
- CENTERLINE OF DRAINAGE SWALE
- LIGHT POLE
- ELECTRIC BOX
- STRUCTURE

SOURCE: MCB, CAMP LEJEUNE, MARCH 2000

FIGURE 8-1
REMEDIAL INVESTIGATION SAMPLING LOCATIONS RECORD OF DECISION, OPERABLE UNIT NO. 6 SITE 54, CRASH CREW FIRE TRAINING BURN PIT CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

ATTACHMENT A
STATE OF NORTH CAROLINA APPROVAL LETTER

North Carolina
Department of Environment and Natural Resources
Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

February 18, 2005

NAVFAC Atlantic
Attn: Daniel R. Hood
Code: OPCEV
NC/Caribbean IPT, EV Business Line
6506 Hampton Blvd
Norfolk, VA 23508-1273

RE: State Concurrence on Record of Decision (ROD)
Operable Unit #6, Sites 36, 43, 44, and 54
Soil and Groundwater
MCB Camp Lejeune, NC, NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Hood:

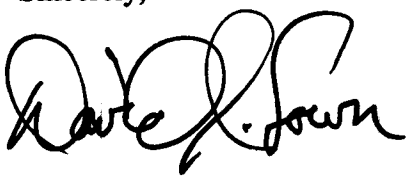
The NC Superfund Section received and reviewed the Final Record of Decision (ROD) for Operable Unit #6, Sites 36, 43, 44, and 54 at Camp Lejeune, MCB and revised insert pages dated February 15, 2005 and concurs with the proposed Final ROD subject to the following condition:

The State's concurrence is based solely on the information contained in the January 2005 Revised Record of Decision and revised insert pages received February 15, 2005 for OU#6 Sites. Should we receive additional information that significantly affects the conclusions of the ROD, we may modify or withdraw this concurrence with written notice to the Naval Facilities Engineering Command for Camp Lejeune and the EPA Region IV.

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-733-4996 \ FAX: 919-715-3605 \ Internet: www.enr.state.nc.us

If you have any questions or comments, please contact me, at (919) 733-4996, extension 278 or email David.Lown@ncmail.net

Sincerely,



David J. Lown, LG, PE, Head
Federal Remediation Branch
Superfund Section

cc: Randy McElveen, NC Superfund Section
Bob Lowder, EMD/IR
Gena Townsend, USEPA

ATTACHMENT B
RI AND POST-RI RESULTS

TABLE B-1
REMEDIAL INVESTIGATION RESULTS FOR SITE 36
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [5]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil	Volatiles	Trichloroethene	2,800	4	4	FDA-SB03	1/61	eastern, former disposal area
		Tetrachloroethene	5,700	2	3	36-GW12	3/61	northern, ground scar area
		Toluene	520,000	8	98	OF-SB01	4/61	south central, open field
		Styrene	1,700,000	39	39	GS-SB03	1/61	northern, ground scar area
		Xylene (total)	210,000	7	7	OF-SB06B	1/61	south central, open field
	Semivolatiles	n-Nitro-di-n-propylamine	69	320	320	DAB-SB03	1/57	southeastern, drum area
		Naphthalene (PAH)	56,000	48	120	OF-SB04	2/57	1 south central, 1 western
		2-Methylnapthalene	1,600,000	54	82	OA-SB01A	2/57	1 south central, 1 western
		Acenaphthene (PAH)	3,700,000	330	330	OF-SB04	1/57	south central, open field
		Dibenzofuran	290,000	150	150	OF-SB04	1/57	south central, open field
		Fluorene (PAH)	2,600,000	200	200	OF-SB04	1/57	south central, open field
		Phenanthrene (PAH)	NA	59	2,500	OF-SB04	4/57	scattered
		Anthracene (PAH)	22,000,000	780	780	OF-SB04	1/57	south central, open field
		Carbazole	NA	240	240	OF-SB04	1/57	south central, open field
		Fluoranthene (PAH)	2,300,000	54	5,500	OF-SB04	5/57	4 southeastern, drum area
		Pyrene (PAH)	2,300,000	41	11,000	OF-SB04	8/57	5 southeastern, drum area
		Butylbenzylphthalate	12,000,000	51	290	OA-SB03	3/57	western
		B(a)anthracene (PAH)	620	46	3,900	OF-SB04	2/57	1 south central, 1 southeastern
		Chrysene (PAH)	62,000	51	4,600	OF-SB04	5/57	3 southeastern, drum area
		B(b)fluoranthene (PAH)	620	51	3,600	OF-SB04	3/57	scattered
		B(k)fluoranthene (PAH)	6,200	39	1,500	OF-SB04	2/57	1 south central, 1 southeastern
		Benzo(a)pyrene (PAH)	62	40	3,300	OF-SB04	2/57	1 south central, 1 western
		I(1,2,3-cd)pyrene (PAH)	620	46	2,700	OF-SB04	3/57	scattered
		D(a,h)anthracene (PAH)	62	720	720	OF-SB04	1/57	south central, open field
		B(g,h,i)perylene (PAH)	NA	2,400	2,400	OF-SB04	1/57	south central, open field
	Pesticides	gamma-BHC (Lindane)	440	4	4	OF-SB06D	1/57	south central, open field
		Aldrin	29	5	5.1	OF-SB03	3/57	1 open field, 2 adjacent toSB01
		Heptachlor	110	1.9	1.9	FCA-SB12	1/57	southwestern, former cleared area
		Heptachlor epoxide	53	2	67	OA-SB01I	10/57	scattered, 3 adjacent to SB01
		Endosulfan I	370000	8.3	36	OA-SB01E	3/57	all adjacent to SB01
		Dieldrin	30	2	16,000	OF-SB03	21/57	scattered
		4-4'-DDE	1700	2.2	2,600	OA-SB01A	49/57	widely scattered, prevalent
		Endrin	18000	9.9	9.9	OA-SB08	1/57	eastern, former disposal area
		4-4'-DDD	2400	2.8	550	OA-SB01A	37/57	widely scattered, prevalent
		Endosulfan Sulfate	NA	2.5	4.2	OF-SB06	2/57	1 south central, 1 western
		4-4'-DDT	1700	1.8	12,000	OA-SB01A	48/57	widely scattered, prevalent
		Endrin Ketone	NA	15	15	OF-SB03	1/57	south central, open field
		Endrin aldehyde	NA	12	12	OF-SB02	1/57	south central, open field
		alpha-Chlordane	1600	1.2	980	OA-SB05	15/57	scattered
		gamma-Chlordane	1600	1.2	840	OA-SB05	10/57	scattered
	PCBs (1)	Aroclor 1248	220	68	24,000	OA-SB01I	9/57	western, surrounding SB01
		Aroclor 1254	220	92	530	OA-SB01	3/57	western, surrounding SB01

TABLE B-1 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 36
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [5]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil (Continued)	Metals	Aluminum	76,000	1,010	17,600	FCA-SB09	52/52	scattered
		Antimony	31	3.3	31.7	OA-SB08	7/46	scattered
		Arsenic	22	0.39	10.4	OA-SB08	43/52	scattered
		Barium	5,400	4.5	141	OA-SB08	51/52	scattered
		Beryllium	150	0.18	0.18	FCA-SB10	1/52	1 detection southwest
		Cadmium	37	0.7	6.3	OA-SB08	8/52	scattered
		Calcium	NA	106	103,000	OF-SB06	51/52	scattered
		Chromium	210	1.6	51.6	OA-SB08	52/52	scattered
		Cobalt	4,700	0.88	9	OA-SB08	10/52	scattered
		Copper	2,900	0.6	445	OA-SB08	39/52	scattered
		Iron	23,000	863	86,200	OA-SB08	52/52	scattered
		Lead	400	4.3	836	OA-SB08	48/52	scattered
		Magnesium	NA	52	1,020	DAD-SB01	52/52	scattered
		Manganese	1,800	2.1	940	OA-SB08	52/52	scattered
		Mercury	23	0.1	2.4	OA-SB05	18/52	scattered
		Nickel	1,600	1	48.3	OA-SB08	26/52	scattered
		Potassium	NA	33.7	676	FCA-SB05	32/52	
		Selenium	390	0.32	0.53	36-SB06D	12/52	
		Silver	390,000	0.6	12	OF-SB04	8/48	3 south central
		Sodium	NA	9.6	358	DAD-SB01	31/52	
		Vanadium	550	2.9	46	OA-SB08	50/52	scattered
		Zinc	23,000	2.1	1,320	OA-SB08	50/52	scattered
Subsurface Soil	Volatiles	Acetone	1,600,000	12	480	GS-SB03	8/62	1 exceeds blank, ground scar area
		1,2-Dichloroethene (total)	63,000	4	4	OA-SB01	1/62	western
		Trichloroethene	2,800	3	5	FDA-SB01	3/62	2 eastern, 1 western
		Benzene	670	3	3	FDA-SB01	1/62	eastern, former disposal area
		Toluene	520,000	5	17	OF-SB06	5/62	south central, open field
		Xylene (total)	210,000	2	6	FDA-SB06	8/62	scattered
	Semivolatiles	1,4-Dichlorobenzene	3,400	97	97	DAB-SB02	1/57	southeastern, drum area
		2-Methylphenol	3,100,000	510	510	DAB-SB01	1/58	southeastern, drum area
		4-Methylphenol	310,000	43	43	DAB-SB01	1/58	southeastern, drum area
		Isophorone	510,000	2,100	2,100	DAB-SB01	1/58	southeastern, drum area
		Naphthalene (PAH)	56,000	41	41	OA-SB01A	1/57	western
		2-Methylnaphthalene	1,600,000	65	85	FDA-SB02	2/57	1 eastern, 1 western
		Phenanthrene (PAH)	NA	48	190	OA-SB07	3/57	scattered
		Di-n-butylphtalate	6,100,000	56	56	OA-SB01	1/58	western
		Fluoranthene (PAH)	2,300,000	130	320	OA-SB07	3/57	2 eastern, 1 south central
		Pyrene (PAH)	2,300,000	59	320	OA-SB07	5/57	scattered
		Butylbenzylphtalate	12,000,000	42	170	OA-SB03	3/57	scattered
		B(a)anthracene (PAH)	620	69	140	OA-SB07	3/57	scattered
		Chrysene (PAH)	62,000	41	200	OA-SB07	5/57	3 eastern, former disposal area
		B(b)fluoranthene (PAH)	620	44	170	OA-SB07	5/57	4 eastern, 1 south central

TABLE B-1 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 36
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [5]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Subsurface Soil (Continued)	Semivolatiles	B(k)fluoranthene (PAH)	6,200	42	68	OA-SB07	3/57	eastern, former disposal area
		Benzo(a)pyrene (PAH)	62	72	450	GS-SB03	4/57	3 eastern, 1 northern
		I(1,2,3-cd)pyrene (PAH)	620	48	110	OA-SB07	3/57	eastern, former disposal area
		B(g,h,i)perylene (PAH)	NA	42	89	OA-SB07	2/57	eastern, former disposal area
	Pesticides	gamma-BHC (Lindane)	440	4	4	OF-SB06D	1/56	open field
		Aldrin	29	1.5	16	36-GW11	5/56	3 southeastern, 2 eastern
		Heptachlor Epoxide	53	3.4	14	36-GW11	3/56	3 eastern, former disposal area
		Dieldrin	30	2.2	1,200	FDA-SB05	17/56	scattered
		4,4'-DDE	1,700	2.3	1,700	OA-SB01A	29/56	widely scattered, prevalent
		Endrin	18,000	2.4	5	OF-SB06B	5/56	scattered
		Endosulfan II	NA	2.0	2.0	OF-SB06B	1/56	south central, open field
		4,4'-DDD	2,400	2.3	1,300	FDA-SB05	30/56	widely scattered, prevalent
		4,4'-DDT	1,700	2.8	3,100	OA-SB01A	28/56	widely scattered, prevalent
		Endrin Aldehyde	NA	3.5	32	FDA-SB05	3/56	2 south central, 1 eastern
		alpha-Chlordane	1,600	1.6	750	36-GW11	12/56	primarily eastern
		gamma-Chlordane	1,600	2.3	770	36-GW11	9/56	primarily eastern
	PCBs (1)	Aroclor 1248	220	19	850	OA-SB01	5/56	western, adjacent to SB01
	Metals	Aluminum	76,000	752	19,700	FDA-SB05	51/51	scattered
		Antimony	31	4.9	21.6	36-GW11	7/44	eastern
		Arsenic	22	0.2	25.9	FDA-SB01	41/51	eastern and central
		Barium	5,400	2	475	36-GW11	50/51	scattered
		Beryllium	150	0.17	0.18	FCA-SB10	2/51	southwestern
		Cadmium	37	0.7	42.8	36-GW11	11/51	eastern and central
		Calcium	NA	15	46,300	OF-SB06B	49/51	scattered
		Chromium	210	1.4	71.9	36-GW11	50/51	eastern and central
		Cobalt	4,700	0.48	9.4	OA-SB07	16/51	
		Copper	2,900	0.5	1,320	OF-SB06B	31/51	scattered
		Iron	23,000	408	132,000	36-GW11	51/51	scattered
		Lead	400	1.2	2,680	OA-SB07	50/51	scattered
		Magnesium	NA	20.2	2,700	36-GW11	51/51	scattered
		Manganese	1,800	0.85	1,260	FDA-SB01	47/51	scattered
		Mercury	23	0.12	3.9	OA-SB07	13/51	east/southeastern
		Nickel	1,600	1.1	72.1	DAD-SB02	24/51	scattered
		Potassium	NA	47.2	1,640	FDA-SB06	32/51	
		Selenium	390,000	0.4	1.2	OF-SB06	4/51	southcentral
		Silver	390	0.55	0.89	36-GW11	3/48	east central
		Sodium	NA	5.2	501	FDA-SB06	34/51	
		Vanadium	550	1.6	52.6	OF-SB06	49/51	scattered
		Zinc	23,000	0.9	2,580	FDA-SB05	41/51	scattered

TABLE B-1 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 36
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [5]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Groundwater	Volatiles (2)	Methylene Chloride	5	1	1	36-GW10	1/29	does not exceed standard
		1,2-Dichloroethene (total)	70	4	37	36-GW10IW	8/29	none exceed standard
		Trichloroethene	2.8	3	97	36-GW10IW	10/29	6 exceed standard, northern
		Tetrachloroethene	0.7	1	2	36-GW10IW	2/29	both exceed standard, northern
		1,1,2,2-Tetrachloroethane	0.17	3	10	36-GW10IW	6/29	northern, former ground scar area
	Semivolatiles	ND	--				0/17	
	Pesticides	4,4'-DDD	0.14	0.06	0.06	36-GW10	1/18	northern, during Round One only
	PCBs	ND	--				0/18	
	Total Metals	Iron	300	3.3	16,900	36-GW02	20/22	12 exceed standard, scattered
		Manganese	50	19.2	3,180	36-GW09	20/22	12 exceed standard, scattered
		Mercury	1.1	1.4	1.4	36-TW02	1/22	1 exceeds standard, southern
Surface Water(3)	Volatiles	1,2-Dichloroethene (total)	2,240	7	7	36-SW02	1/7	UT, upgradient of open field
	Semivolatiles	ND	--				0/7	
	Pesticides	ND	--				0/7	
	PCBs	ND	--				0/7	
	Metals (4)	Copper	6.5	56.5	56.5	36-SW01	1/7	1 exceeds fresh standard, not background
		Iron	1,000	967	4840	36-SW03	7/7	3 exceed fresh standard and background
		Nickel	8.3	16.4	31.4	36-SW02	4/7	1 exceeds salt standard
Sediment	Volatiles	Tetrachloroethane	NA	4	4	36-SD04	1/13	near mouth of UT at BC
	Semivolatiles	Diethylphthalate	NA	330	2,135	36-SD05	3/13	UT and near mouth of UT
		Anthracene	85	46	46	36-SD04	1/13	does not exceed standard, UT
		Di-n-butylphthalate	NA	218	218	36-SD06	1/13	BC, adjacent to ground scar area
		Pyrene (PAH)	350	316	316	36-SD02	1/13	UT, does not exceed standard
	Pesticides	Aldrin	NA	0.9	0.9	36-SD01	1/13	UT, upgradient
		Dieldrin	NA	0.8	52	36-SD06	3/13	2 from BC, minimum from UT
		4,4'-DDE	2	32	1,200	36-SD05	9/13	9 exceed standard, higher in BC
		Endrin	0.02	6.6	6.6	36-SD02	1/13	UT, upgradient of open field
		4,4'-DDD	2	14	1,140	36-SD05	12/13	12 exceed standard
		Endosulfan Sulfate	NA	3	3	36-SD02	1/13	UT, upgradient of open field
		4,4'-DDT	1	3	46	36-SD05	11/13	11 exceed standard
		Endrin Ketone	NA	11	11	36-SD03	1/13	UT, adjacent to open field
		Endrin Aldehyde	NA	3.5	7.6	36-SD05	2/13	1 from BC, 1 from UT
		alpha-Chlordane	0.5	6.5	13	36-SD07	2/13	2 exceed standard, upgradient BC
	PCBs	ND	--				0/13	
	Metals (4)	Cadmium	5	1.4	8.7	36-SD02	2/15	1 exceeds standard and background, UT
		Lead	35	7.1	15,100	36-SD06	12/15	7 exceed standard, 1 exceeds background
		Mercury	0.15	0.2	0.7	36-SD04	3/4	3 exceed standard, 11 rejected
		Nickel	30	2.1	77.1	36-SD03	11/15	1 exceeds standard, from UT
		Zinc	120	25.3	140	36-SD02	5/5	1 exceeds standard, not background, UT

TABLE B-1 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 36
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Notes:

- Concentrations are presented in ug/L for liquid and ug/Kg for solids (ppb), metal concentrations for soils and sediments are presented in mg/Kg (ppm).
  (1) PCB contaminated soil was removed during the removal action that OHM conducted in 1997.
  (2) An additional round of groundwater samples were collected from wells which exhibited concentrations of volatiles during the first round.
  (3) Surface water detections were compared to appropriate NCWQS and NOAA screening values, based upon the observed percentage of saltwater at each sampling location.
  (4) Total metals in surface water and sediment were compared to the range of positve detections in upgradient samples at MCB, Camp Lejeune.
  (5) Screening criteria are provided as a reference point and are Region IX Residential PRGs for surface and subsurface soil, NCWQS for groundwater, and NOAA for surface water and sediment

BC - Brinson Creek
BEHP - bis(2-ethylhexyl)phthalate
NA - Not applicable
NCWQS - North Carolina Water Quality Standard
ND - Not detected
NOAA - National Oceanic and Atmospheric Administration
MCL - Federal Maximum Contaminant Level
PAH - Polynuclear aromatic hydrocarbon
UT - Unnamed Tributary

TABLE B-2
SITE 36
POST RI MONITORING DETECTIONS
OPERABLE UNIT NO. 6
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

WELL ID	NCWQS	October 1998	January 1999	April 1999	July 1999	October 1999	January 2000	April 2000	July 2000	October 2000	January 2001	April 2001	July 2001	October 2001	January 2002	April 2002	October 2002
36-GW03																	
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**11 J**	ND
36-GW09																	
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	**4 J**	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28**
36-GW10																	
1,1,2,2-Tetrachloroethane	0.17 (1)	**1 J**	ND	ND	**8**	ND	**4 J**	**6**	**3 J**	**5**	**8**	ND	**4 J**	**3 J**	**4J**	ND	ND
2-Butanone	170	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	NE	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28**
Methylene Chloride	5	ND	ND	**3 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	2.8	**3 J**	**2 J**	**1 J**	**10**	ND	**8**	**11**	**4 J**	**7**	**12**	**4 J**	**9**	**7**	**11**	**4 J**	**4 J**
36-GW10DW																	
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	5	ND	ND	**2 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36-GW10IW																	
1,1,2,2-Tetrachloroethane	0.17 (1)	**4 J**	**3 J**	**2 J**	**4 J**	**4 J**	**6**	**6**	**6**	**8**	**7**	**10**	**9**	**8**	**7**	**10 J**	**7**
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	5	ND	ND	**3 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	70	**21**	**17**	**19**	**21**	**23**	**26**	**20**	**20**	**20**	**21**	**18**	**20**	**21**	**20**	**24**	**17**
Vinyl Chloride	0.015	**3 J**	ND	**1 J**	ND	**2**	**2**	ND	**2**	**2 J**	ND	ND	ND	ND	**2**	ND	**2 J**
Tetrachloroethene	0.7																**0.7 J**
Trichloroethene	2.8	**41**	**31**	**38**	**43**	**50**	**46**	**44**	**44**	**49**	**47**	**43**	**49**	**49**	**44**	**54**	**49**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**23**	**20**	**27**	**19**
trans-1,2-Dichloroethene	70	ND	**1 J**	**1 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**3 J**	**2 J**
36-GW13																	
1,1,2,2-Tetrachloroethane	0.17 (1)	**3 J**	ND	**1 J**	ND	**4 J**	ND	ND	ND	**3 J**	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**29**
cis-1,2-Dichloroethene	70	**2 J**	**3 J**	**4 J**	**3 J**	**3 J**	**4 J**	**3 J**	**ND**	**2 J**	**4 J**	**3 J**	**3 J**	**4 J**	**ND**	**3 J**	**2 J**
Vinyl Chloride	0.015	**3 J**	ND	**4 J**	ND	**1 J**	**2**	**3**	**1 J**	**1 J**	ND	ND	ND	ND	**1 J**	ND	**1 J**
Trichloroethene	2.8	**2 J**	**1 J**	**2 J**	**2 J**	**3 J**	ND	ND	ND	**2 J**	ND	**3 J**	**3 J**	**3 J**	**3 J**	**3 J**	**3 J**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**4 J**	ND	**3 J**	**3 J**
trans-1,2-Dichloroethene	70	**2 J**	**2 J**	**2 J**	ND	ND	**2 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.9 J**
36-GW13IW																	
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	**3 J**	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28**
Methylene Chloride	5	ND	ND	**1 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**3 J**	ND	ND	ND
cis-1,2-Dichloroethene	70	**4 J**	**3 J**	**3 J**	**4 J**	**5 J**	**4 J**	**3 J**	**3 J**	ND	**3 J**	**3 J**	**4J**	ND	**3 J**	**4 J**	**3 J**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**3 J**	**3 J**	**4 J**	**3 J**
Vinyl Chloride	0.015	ND	ND	ND	ND	ND	**1 J**	ND	**2 J**	**1 J**	ND	ND	**1J**	**1 J**	**2 J**	ND	**2 J**

TABLE B-2 (continued)
SITE 36
POST RI MONITORING DETECTIONS
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

WELL ID	NCWQS	October 1998	January 1999	April 1999	July 1999	October 1999	January 2000	April 2000	July 2000	October 2000	January 2001	April 2001	July 2001	October 2001	January 2002	April 2002	October 2002
36-GW16IW																	
1,1,2,2-Tetrachloroethane	0.17 (1)	**3 J**	**4 J**	**9**	**17**	**16 J**	**13**	**11**	**16**	**24**	**16**	**16**	**20**	**21**	**20**	**34 J**	**18**
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	**2 J**	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28**
cis-1,2-Dichloroethene	70	**4 J**	**5**	**5**	**6**	**7**	**6**	**6**	**6**	**5**	ND	**6**	**7**	**7**	**7**	**8**	**7**
Tetrachloroethene	0.7																**0.8 J**
Trichloroethene	2.8	**5 J**	**8**	**13**	**21**	**24**	**20**	**19**	**21**	**26**	**26**	**25**	**30**	**31**	**28**	**40**	**36**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9**	**7**	**8**	**9**
trans-1,2-Dichloroethene	70																**2 J**
Vinyl Chloride	0.015	ND	ND	ND	ND	ND	**1 J**	ND	ND	ND	ND	ND	ND	**1 J**	**1 J**	ND	**1 J**
36-GW18																	
1,1,2,2-Tetrachloroethane	0.17 (1)	**4 J**	ND	**1 J**	**3 J**	ND	ND	ND	**2 J**	ND	ND	ND	ND	NS	ND	ND	**1 J**
2-Butanone	170	**4 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND
Acetone	700	ND	ND	**3 J**	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	**28**
Methylene Chloride	5	ND	ND	**3 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND
cis-1,2-Dichloroethene	70	**3 J**	**2 J**	**2 J**	**4 J**	**3 J**	**3 J**	**5 J**	**6**	**4 J**	**4 J**	**4 J**	**7**	NS	**5 J**	**6**	**5**
trans-1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	**3 J**	**2 J**
Trichloroethene	2.8	**4 J**	**3 J**	**3 J**	**4 J**	**3 J**	**3 J**	**4 J**	**4 J**	**3 J**	**3 J**	**2 J**	**4 J**	NS	**3 J**	**4 J**	**5 J**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	**5 J**	**8**	**8**
Vinyl Chloride	0.015	ND	ND	ND	ND	**8**	ND	ND	**2**	**1 J**	ND	ND	**2 J**	NS	**1 J**	ND	**2**
36-GW18IW																	
2-Hexanone	280 (1)	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	700	ND	ND	ND	ND	**10 R**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28**
cis-1,2-Dichloroethene	70	**16**	**14**	**15**	**13**	**13**	**15**	**12**	**11**	**11**	**12**	**10**	**12**	**12**	**10**	**13**	**10**
Trichloroethene	2.8	**2 J**	**2 J**	**2 J**	ND	**13**	ND	ND	ND	**2 J**	**3 J**	**3 J**	**3 J**	**3 J**	**3 J**	**4 J**	**3 J**
Total 1,2-Dichloroethene	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**13**	**10**	**13**	**10**
Vinyl Chloride	0.015	**3 J**	ND	**2 J**	ND	**2 J**	**2 J**	ND	ND	**2 J**	ND	ND	**2**	**3**	**2**	ND	**2**
36-GW19																	
Methylene Chloride	5	ND	ND	**2 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	NS	NS
36-GW20IW		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
cis-1,2-Dichloroethene	70																**1 J**
Trichloroethene	2.8					**THIS WELL DID NOT EXIST UNTIL 10/2002**											**1 J**
Total 1,2-Dichloroethene	70																**1 J**
36-GW21IW		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2,2-Tetrachloroethane	0.17 (1)																**16**
2-Hexanone	280 (1)					**THIS WELL DID NOT EXIST UNTIL 10/2002**											ND
Acetone	700																ND
cis-1,2-Dichloroethene	70																**5**
Tetrachloroethene	0.7																**1 J**
Trichloroethene	2.8																**46**
Total 1,2-Dichloroethene	70																**6**
trans-1,2-Dichloroethene	70																**1 J**
Vinyl Chloride	0.015																ND

- All concentrations in ug/L

Shaded constituents exceed the NCWQS standards

Notes:

ND - Not Detected
NE - Not Established
(1) NCWQS Interim Standard
NS - Not Sampled
J - Analyte detected; value is estimated
R - Rejected Data

TABLE B-3
REMEDIAL INVESTIGATION RESULTS FOR SITE 43
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [3]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil	Volatiles	ND	--				0/7	
	Semivolatiles	4-Methylphenol	310,000	120	120	DA1-SB02	1/28	northeastern portion of site
		2-Methylnapthalene	1,600,000	74	74	WA-SB01A	1/28	clearing adjacent to 43-GW01
		Acenaphthylene	NA	71	71	WA-SB01A3	1/28	clearing adjacent to 43-GW01
		Acenaphthene (PAH)	3,700,000	45	2,100	WA-SB01A	3/28	clearing adjacent to 43-GW01
		Dibenzpfuran	290,000	35	870	WA-SB01A	2/28	clearing adjacent to 43-GW01
		Fluorene (PAH)	2,600,000	53	1,700	WA-SB01A	3/28	clearing adjacent to 43-GW01
		Phenanthrene (PAH)	NA	54	5,900	WA-SB01A	8/28	clearing adjacent to 43-GW01
		Anthracene (PAH)	22,000,000	44	820	WA-SB01A	3/28	clearing adjacent to 43-GW01
		Carbazole	NA	99	350	WA-SB01A	5/28	clearing adjacent to 43-GW01
		Fluoranthene (PAH)	2,300,000	49	60,000	WA-SB01A	10/28	clearing adjacent to 43-GW01
		Pyrene (PAH)	2,300,000	49	64,000	WA-SB01A	10/28	clearing adjacent to 43-GW01
		Butylbenzylphthalate	12,000,000	50	420	OA-SB03	3/28	maximum northeast of clearing
		B(a)anthracene (PAH)	620	51	40,000	WA-SB01A	9/28	clearing adjacent to 43-GW01
		Chrysene (PAH)	62,000	110	46,000	WA-SB01A	9/28	clearing adjacent to 43-GW01
		B(b)fluoranthene (PAH)	620	44	52,000	WA-SB01A	10/28	clearing adjacent to 43-GW01
		B(k)fluoranthene (PAH)	6,200	57	20,000	WA-SB01A	9/28	clearing adjacent to 43-GW01
		Benzo(a)pyrene (PAH)	62	79	39,000	WA-SB01A	9/28	clearing adjacent to 43-GW01
		I(1,2,3-cd)pyrene (PAH)	620	42	27,000	WA-SB01A	10/28	clearing adjacent to 43-GW01
		D(a,h)anthracene (PAH)	62	47	1,200	WA-SB01A	8/28	clearing adjacent to 43-GW01
		B(g,h,i)perylene (PAH)	NA	87	24,000	WA-SB01A	9/28	clearing adjacent to 43-GW01
	Pesticides	Heptachlor epoxide	53	2	2	WA-SB01A	1/7	clearing adjacent to 43-GW01
		4-4'-DDE	1,700	5.7	1,000	DA1-SB03	5/7	maximum northeast
		4-4'-DDD	2,400	3,000	3,000	DA1-SB03	1/7	northeastern portion of site
		4-4'-DDT	1,700	10	1,000	DA1-SB03	4/7	maximum northeast
		Endrin aldehyde	NA	5.4	5.4	DA2-SB03	1/7	north of clearing
	PCBs	ND	--	--	--	--	0/7	
	Metals	Cadmium	37	0.7	1.7	WA-SB02	2/21	separate areas
		Chromium	210	1.1	106	DA1-SB02	21/21	scattered

TABLE B-3 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 43
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [3]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil (continued)	Metals (continued)	Copper	2,900	0.5	55.7	DA2-SB01	17/21	north of clearing
		Lead	400	4.3	246	DA2-SB01	20/21	scattered
		Manganese	1,800	2.8	189	DA2-SB01	21/21	scattered
		Mercury	23	0.1	0.5	DA1-SB02	3/21	drum areas
		Nickel	1,600	1.1	5	DA2-SB01	8/21	scattered
		Zinc	23,000	1.5	595	DA1-SB02	21/21	scattered
Subsurface Soil	Volatiles	ND	--				0/7	
	Semivolatiles	Phenanthrene (PAH)	NA	430	430	WA-SB02	1/20	clearing adjacent to 43-GW01
		Carbazole	NA	73	73	WA-SB02	1/20	clearing adjacent to 43-GW01
		Fluoranthene (PAH)	2,300,000	850	850	WA-SB02	1/20	clearing adjacent to 43-GW01
		Pyrene (PAH)	2,300,000	1,800	1,800	WA-SB02	1/20	clearing adjacent to 43-GW01
		Butylbenzylphtalate	12,000,000	39	440	OA-SB03	2/20	north of clearing
		B(a)anthracene (PAH)	620	390	390	WA-SB02	1/20	clearing adjacent to 43-GW01
		Chrysene	62,000	740	740	WA-SB02	1/20	clearing adjacent to 43-GW01
		B(b)fluoranthene (PAH)	620	780	780	WA-SB02	1/20	clearing adjacent to 43-GW01
		B(k)fluoranthene (PAH)	6,200	340	340	WA-SB02	1/20	clearing adjacent to 43-GW01
		Benzo(a)pyrene (PAH)	62	570	570	WA-SB02	1/20	clearing adjacent to 43-GW01
		I(1,2,3-cd)pyrene (PAH)	620	890	890	WA-SB02	1/20	clearing adjacent to 43-GW01
		B(g,h,i)perylene (PAH)	NA	790	790	WA-SB02	1/20	clearing adjacent to 43-GW01
	Pesticides	4,4'-DDE	1,700	9	9	DA1-SB03	1/7	northeastern portion or site
		4,4'-DDD	2,400	1,200	1,200	DA1-SB03	1/7	northeastern portion or site
		4,4'-DDT	1,700	45	45	DA1-SB03	1/7	northeastern portion or site
	PCBs	ND	--				0/7	
	Metals	Copper	2,900	0.4	3.6	OA-SB01	6/20	north of clearing
Groundwater	Volatiles	ND	--				0/10	
	Semivolatiles	4-Methylphenol	3.5	2	2	43-TW04	1/10	north near SHC and EC
	Pesticides	ND	--				0/10	
	PCBs	ND	--				0/6	
	Total Metals	Iron	300	109	33,800	43-TW04	10/10	8 exceed standard, scattered
		Manganese	50	4.4	107	43-TW04	10/10	2 exceed standard, central and north

TABLE B-3 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 43
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [3]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Water (1)	Volatiles	1,2-Dichloroethene (total)	2,240	2	2	EC-SW02	2/6	neither exceed standard, EC
	Semivolatiles	ND	--				0/6	
	Pesticides	4,4-DDE	0.14	0.1	0.1	EC-SW01	2/6	do not exceed standard, 1 EC, 1 SHC
		4,4-DDD	0.025	0.1	0.6	EC-SW01	3/6	3 exceed standard, 1 EC, 2 SHC
	PCBs	ND	--				0/6	
	Metals (2)	Copper	2.9	1.8	3.2	EC-SW02	3/6	1 exceed standard, not background
Sediment	Volatiles	Carbon Disulfide	NA	3	26	EC-SD02	3/12	2 from EC and 1 from SHC
	Semivolatiles	4-Methylphenol	NA	210	210	SHC-SD03	1/12	adjacent to study area, SHC
		Pyrene (PAH)	350	200	200	EC-SD02	1/12	does not exceed standard, EC
		Benzo(a)pyrene (PAH)	400	290	1,900	SHC-SD02	4/12	3 exceed standard, 2 EC and 1 SHC
	Pesticides	4,4'-DDE	2	12	8,900	SHC-SD04	10/12	10 exceed standard, scattered
		Endrin	NA	12	16	EC-SD01	2/11	1 detection EC and 1 SHC
		4,4'-DDD	2	5.6	37,000	SHC-SD04	11/12	11 exceed standard, scattered
		4,4'-DDT	1	9.3	180	EC-SD01	6/12	6 exceed standard, scattered
		alpha-Chlordane	0.5	7.2	49	SHC-SD03	8/12	8 exceed standard, scattered
		gamma-Chlordane	0.5	9.6	74	SHC-SD03	9/12	9 exceed standard, scattered
	PCBs	ND	--				0/9	
	Metals (2)	Lead	35	6.1	206	SHC-SD03	12/12	7 exceed standard, none exceed background
		Mercury	0.15	0.4	0.7	EC-SD01	2/12	2 exceed standard
		Silver	1	1.9	2.8	EC-SD02	2/12	2 exceed standard, neither exceed BB
		Zinc	120	1.5	338	EC-SD01	12/12	4 exceed standard, none exceed background

Notes:

- Concentrations are presented in µg/L for liquid and µg/Kg for solids (ppb), metal concentrations for soils and sediments are presented in mg/Kg (ppm).
(1) Positive contaminant detections in surface water were compared to appropriate NCWQS and NOAA saltwater screening values.
(2) Total metals in surface water and sediment were also compared to the range of positive detections in upgradient samples at MCB, Camp Lejeune.
(3) Screening criteria are provided as a reference point and are Region IX Residential PRGs for surface and subsurface soil, NCWQS for groundwater, and NOAA for surface water and sediment

ARAR - Applicable or Relevant and Appropriate Requirements
BC - Brinson Creek
BEHP - bis(2-ethylhexyl)phthalate
NCWQS - North Carolina Water Quality Standard
EC - Edwards Creek
NA - Not applicable
ND - Not detected
NOAA - National Oceanic and Atmospheric Administration

Table B-4
REMEDIAL INVESTIGATION RESULTS FOR SITE 44
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [3]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil	Volatiles	ND	--				0/13	
	Semivolatiles	bis(2-Chloroethyl)ether	210	550	550	OA-SB06	1/13	eastern
		2,6-Dinitrotoluene	61,000	380	380	OA-SB02	1/13	open area
		I(1,2,3-cd)pyrene (PAH)	620	220	220	OA-SB05	1/13	east central
		B(g,h,i)perylene (PAH)	NA	57	200	OA-SB05	2/13	east central
	Pesticides	4-4'-DDE	1,700	10	140	OA-SB05	4/13	scattered
		4-4'-DDD	2,400	7.4	7.4	OA-SB03	1/13	near march area
		4-4'-DDT	1,700	4.6	4.5	OA-SB03	4/13	scattered
	PCBs	ND	--				0/7	
	Metals	Arsenic	26.2	0.8	4.9	WA-SB02	13/13	evenly dispersed
		Chromium	210	4.2	16.4	OA-SB01	12/13	evenly dispersed
		Copper	2,900	0.9	910	OA-SB03	12/13	near marsh area
		Lead	400	5.9	31.7	OA-SB03	11/13	near marsh area
		Manganese	1,800	4.9	44.2	OA-SB03	13/13	evenly dispersed
		Zinc	23,000	2.7	156	OA-SB03	13/13	max. near marsh
Subsurface Soil	Volatiles	ND	--				0/13	
	Semivolatiles	I(1,2,3-cd)pyrene (PAH)	620	55	130	OA-SB05	2/13	east central
		B(g,h,i)perylene (PAH)	NA	40	120	OA-SB05	3/13	east central
	Pesticides	4-4'-DDE	1,700	3.2	370	44-GW01DW	4/13	scattered
		4-4'-DDD	2,400	5.6	2,500	44-GW01DW	4/13	scattered
		4-4'-DDT	1,700	150	150	44-GW01DW	1/13	central
	PCBs	ND	--				0/7	
	Metals	Arsenic	26	0.3	2.5	WA-SB04	10/13	west central
		Copper	2,900	0.4	3	44-GW01DW	9/13	central
		Lead	400	1.4	9	44-GW01DW	11/13	central
		Manganese	1,800	1.3	9.3	WA-SB02	13/13	2 exceed BB
		Nickel	1,600	1.3	15.8	44-GW01DW	6/13	2 exceed BB
		Zinc	23,000	0.8	10.8	WA-SB04	12/13	west central
Groundwater	Volatiles	Vinyl Chloride	0.015	10	10	44-TW01	1/9	1 exceeds standard, marsh area
		1,2-Dichloroethene (total)	70	15	15	ww-TW01	1/9	does not exceed standard, marsh
		Trichloroethene	2.8	1	1	44-TW01	1/9	does not exceed standard, marsh
		Tetrachloroethene	0.17	1	1	44-GW03	1/9	1 exceeds standard, southwestern

Table B-4 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 44
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [3]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Groundwater (continued)	Semivolatiles	Naphthalene (PAH)	21	71	71	44-GW03	1/9	1 exceed standard, southwestern
		2-Methylnaphthalene	28	4	4	44-GW03	1/9	southwestern, near access road
		Acenaphthene (PAH)	80	13	13	44-GW03	1/9	does not exceed standard
		Dibenzofuran	28	6	6	44-GW03	1/9	southwestern, near access road
		Fluorene (PAH)	280	7	7	44-GW03	1/9	does not exceed standard
		Phenanthrene (PAH)	210	7	7	44-GW03	1/9	does not exceed standard
		Carbazole	NA	4	4	44-GW03	1/9	southwestern, near access road
	Pesticides	ND	--				0/9	
	PCBs	ND	--				0/9	
	Total Metals	Iron	300	285	72,900	44-GW04	9/9	8 exceed standard, scattered
		Manganese	50	21.6	241	44-GW04	8/9	5 exceed standard, scattered
Surface Water (1)	Volatiles	Vinyl Chloride	525	7	38	EC-SW08	8/16	max. upgradient, decreases by site
		1,1-Dichloroethene	303	1	2	EC-SW06	3/16	each detection upgradient
		1,2-Dichloroethene (total)	NA	2	150	EC-SW01	14/16	max. upgradient, decrease by site
		Trichloroethene	92.4	2	66	EC-SW01	14/16	max. upgradient, decreases by site
		1,1,2-Trichloroethane	940	1	1	EC-SW08	1/16	upgradient
		1,1,2,2-Tetrachloroethane	10.8	5	42	EC-SW08	12/16	9 exceed standard, max. upgradient
	Semivolatiles	Phenol	58	1	1	UT-SW01	1/8	low detection, UT
	Pesticides	ND	--				0/8	
	PCBs	ND	--				0/8	
	Metals (3)	Lead	1.3	0.8	11.2	EC-SW02	2/8	1 exceeds standard and background
		Zinc	58.9	17.3	61.3	EC-SW03	7/8	1 exceeds standard, not background
Sediment	Volatiles	Acetone	NA	15	610	UT-SD01	11/16	1 exceeds blank cont. level (240)
	Semivolatiles	Pentachlorophenol	NA	340	740	EC-SD01	2/16	up and downgradient, EC
		Penanthrene (PAH)	225	49	250	UT-SD03	5/16	primarily UT
		Carbazole	NA	79	79	UT-SD03	1/16	near confluence with EC, UT
		Fluoranthene (PAH)	600	95	740	UT-SD03	6/16	1 exceeds standard, UT
		Pyrene (PAH)	350	42	490	UT-SD03	7/16	1 exceeds standard, UT
		Butylbenzylphthalate	NA	48	48	UT-SD02	1/16	by concrete outflow/culvert, UT
		B(a)anthracene (PAH)	230	50	170	UT-SD03	3/16	do not exceed standard, UT
		Chrysene (PAH)	400	44	460	UT-SD03	7/16	1 exceeds standard, UT
		B(b)fluoranthene (PAH)	NA	52	600	UT-SD03	6/16	UT and downgradient of UT

Table B-4 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 44
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria (3)	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Sediment (continued)	Semivolatiles (continued)	B(k)fluoranthene (PAH)	NA	49	200	UT-SD03	3/16	all detections from UT
		Benzo(a)pyrene (PAH)	400	56	300	UT-SD03	3/16	do not exceed standard, UT
		B(g,h,i)perylene (PAH)	NA	49	71	UT-SD02	2/16	1 detection EC and 1 UT
	Pesticides	Aldrin	NA	2.6	2.6	UT-SD03	1/14	UT
		Heptachlor Epoxide	NA	5.2	5.2	UT-SD03	1/14	UT
		4-4'-DDE	2	9.3	310	UT-SD02	16/16	16 exceed standard
		4-4'-DDD	2	5.5	770	UT-SD02	16/16	16 exceed standard
		4-4'-DDT	1	2.5	130	EC-SD05	10/14	10 exceed standard, prevalent
		alpha-Chlordane	.05	2	14	EC-SD05	13/16	13 exceed standard, prevalent
		gamma-Chlordane	.05	2.7	16	EC-SD05	13/16	13 exceed standard, prevalent
	PCBs	ND	--				0/13	
	Metals (2)	Lead	35	8.4	56.3	UT-SD03	16/16	3 exceed standard, not background
		Zinc	120	6.3	144	EC-SD05	16/16	1 exceeds standard, not background

Notes:
- Concentrations are presented in ug/L for liquid and ug/Kg for solids (ppb), metal concentrations for soils and sediments are presented in mg/Kg (ppm).

(1) Surface water detections were compared to appropriate NCWQS and NOAA screening values, based upon the observed percentage of saltwater at each sampling location.
(2) Total metals in surface water and sediment were compared to the range of positive detections in upgradient samples at MCB, Camp Lejeune.
(3) Screening criteria are provided as a reference point and are Region IX Residential PRGs for surface and subsurface soil, NCWQS for groundwater, and NOAA for surface water and sediment

BEHP - bis(2-ethylhexyl)phthalate
EC - Edwards Creek
NA - Not applicable
NCWQS - North Carolina Water Quality Standard
UT - Unnamed Tributary
NOAA - National Oceanic and Atmospheric Administration
MCL - Federal Maximum Contaminant Level
PAH - Polynuclear aromatic hydrocarbon

Table B-5
REMEDIAL INVESTIGATION RESULTS FOR SITE 54
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [1]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Surface Soil	Volatiles	ND	--				0/11	
	Semivolatiles	n-Nitrosodiphenylamine	99,000	160	160	DD-SB01	1/11	south, drainage ditch
		Phenanthrene (PAH)	NA	98	120	DD-SB03	2/11	south, drainage ditch
		Fluoranthene (PAH)	2,300,000	62	67	DD-SB01	2/11	south, drainage ditch
		Pyrene (PAH)	2,300,000	99	150	DD-SB01	2/11	south, drainage ditch
		Butylbenzylphthalate	12,000,000	50	320	DD-SB04	2/11	south, drainage ditch
		Di-n-octylphthalate	NA	150	150	SB08	1/11	southwest of burn pit
	PCBs	ND	--				0/4	
	Metals	Chromium	210	5.7	9.1	DD-SB04	4/4	drainage ditch
		Zinc	23,000	8.3	16.7	DD-SB04	4/4	2 exceed BB, drainage ditch
Subsurface Soil	Volatiles	Acetone	1,600,000	1,200	1,200	DD-SB05	1/19	1 exceeds blank, drainage ditch
		Xylene (total)	210,000	12	300	SB08	2/19	southwest of burn pit
	Semivolatiles	Naphthalene (PAH)	56,000	760	760	SB08	1/19	southwest of burn pit
		2-Methylnaphthalene	1,600,000	1,700	1,700	DD-SB05	1/19	south, drainage ditch
		Acenaphthene (PAH)	3,700,000	94	94	DD-SB05	1/19	south, drainage ditch
		Fluorene (PAH)	2,600,000	420	420	DD-SB05	1/19	south, drainage ditch
		Phenanthrene (PAH)	NA	160	160	DD-SB05	1/19	south, drainage ditch
		Pyrene (PAH)	2,300,000	43	43	DD-SB05	1/19	south, drainage ditch
		Butylbenzylphtalate	12,000,000	56	56	DD-SB03	1/19	south, drainage ditch
	PCBs	ND	--				0/8	
	Metals	Lead	400	1.4	11.5	DD-SB03	8/8	scattered
		Nickel	1,600	1.1	6.2	DD-SB02	6/8	south and southwest
Groundwater	Volatiles	Carbon Disulfide	700	4	4	54-GW10	1/17	does not exceed standard, east
		1,2-Dichloroethene (total)	NA	5	23	54-TW03	3/17	none exceed standard, southeast
		Trichloroethene	2.8	1	1	54-TW03	1/17	does not exceed standard, southeast
		Benzene	1	5	40	54-TW04	6/17	6 exceed standard, south and east
		Toluene	1,000	22	83	54-TW03	2/17	do not exceed standard, southeast
		Ethylbenzene	29	6	26	54-TW04	3/17	none exceed standard, southeast
		Xylene (total)	530	27	130	54-TW03	3/17	none exceed standard, southeast

Table B-5 (continued)
REMEDIAL INVESTIGATION RESULTS FOR SITE 54
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Fraction	Detected Contaminants	Screening Criteria [1]	Site Contamination		Maximum Location	Detection Frequency	Distribution
				Min.	Max.			
Groundwater (continued)	Semivolatiles	Phenol	300	1	1	54-TW04	1/17	does not exceed standard, east
		Nitrobenzene	NA	2	2	54-TW04	1/17	east of burn pit, adjacent to UST
		2,4-Dimethylphenol	140	3	3	54-TW06	1/17	east of burn pit, adjacent to UST
		Naphthalene (PAH)	21	1	240	54-TW03	7/17	5 exceed standard, south and east
		2-Methylnaphthalene	28	1	160	54-TW03	6/17	south and east, 3 of 6 at UST
		Diethylphthalate	5,000	1	37	54-TW03	5/17	none exceed standard, southeast
		Anthracene (PAH)	2,100	1	1	54-TW05	1/17	does not exceed standard, UST
		Di-n-butylphthalate	700	1	2	54-GW09	2/17	do not exceed standard, scattered
	Pesticides	ND	--				0/1	
	PCBs	ND	--				0/13	
		Iron	300	193	74,100	54-TW03	12/13	9 exceed standard, scattered
	Metals	Lead	15	1.9	39.7	54-GW02	5/13	1 exceeds standard, upgradient
		Manganese	50	25.2	1,280	54-GW03	13/13	9 exceed standard, scattered

Notes:
- Concentrations are presented in ug/L for liquid and ug/Kg for solids (ppb), metal concentrations for soils and sediments are presented in mg/Kg (ppm).

(1) Screening criteria are provided as a reference point and are Region IX Residential PRGs for surface and subsurface soil and NCWQS for groundwater

ARAR - Applicable or Relevant and Appropriate Requirements
NA - Not applicable
NCWQS - North Carolina Water Quality Standard
ND - Not detected
NOAA - National Oceanic and Atmospheric Administration
MCL - Federal Maximum Contaminant Level
PAH - Polynuclear aromatic hydrocarbon

TABLE B-6
SITE 54 POST RI MONITORING DATA [1]
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Date of Sampling Event	Semivolatiles Detected Above NCWQS	Result	NCWQS Screening Criteria	Location
January 2000	ND	--	NA	NA
April 2000	ND	--	NA	NA
July 2000	Bis(2-Ethylhexyl) Phthalate	6J	3	54-GW12
October 2000	Bis(2-Ethylhexyl) Phthalate	5J	3	54-GW09
January 2001	Bis(2-Ethylhexyl) Phthalate	17	3	54-GW10
October 2001	4-Methylphenol	350 J	3.5 [2]	54-GW11
	Naphthalene	1200 J	21	54-GW11
	Phenol	600 J	300	54-GW11
January 2002	Bis(2-Ethylhexyl) Phthalate	210	3	54-GW11
April 2002	ND for lead	--	15	54-GW02
July 2002	ND for lead	--	15	54-GW02

- All concentrations reported in ug/L

Notes:
(1) There were no VOC detections exceeding the NCWQS during the shown reporting periods
(2) Interim Standard

J - Analyte was positively identified, value is estimated
NA - Not Applicable
NCWQS - North Carolina Water Quality Standards
ND - None Detected above NCWQS

ATTACHMENT C
RISK ASSESSMENT TABLES

TABLE C-1
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Surface Soil	**Semivolatiles:** n-Nitroso-di-n-propylamine Benzo(a)anthracene Benzo(b)fluoranthene Benzo(a)pyrene Idenco(1,2,3-cd)pyrene Dibenzo(a,h)anthracene **Pesticides:** Aldrin Dieldrin 4,4'-DDE 4,4'-DDT alpha-Chlordane gamma-Chlordane Aroclor-1248 Aroclor-1254 **Inorganics:** Aluminum Antimony Arsenic Cadmium Chromium Copper Iron Lead Mercury
Subsurface Soil	**Semivolatiles:** Benzo(a)pyrene Dieldrin 4,4'-DDT alpha-Chlordane gamma-Chlordane Aroclor-1248

TABLE C-1 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Subsurface Soil (continued)	**Inorganics:** Aluminum Antimony Arsenic Beryllium Cadmium Chromium Copper Iron Lead Manganese Mercury Zinc
Groundwater	**Volatiles:** 1,2-Dichloroethene (total) Trichloroethene Tetrachloroethene 1,1,2,2-Tetrachloroethane **Semivolatiles:** Bis(2-ethylhexyl)phthalate **Metals:** Arsenic Barium Cadmium Iron Manganese
Surface Water	**Volatiles:** 1,2-Dichloroethene (total) **Inorganics:** Antimony Barium Iron Manganese Molybdenum Vanadium

TABLE C-1 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Sediment	**Volatiles:** Tetrachloroethene
Sediment (continued)	**Semiolatiles:** Diethylphthalate Anthracene Di-n-butylphthalate Bis(2-ethylhexyl)phthalate **Pesticides:** Dieldrin 4,4'-DDE Endrin 4,4'-DDD Endosulfan sulfate 4,4-DDT Endrin ketone Endrin aldehyde alpha-Chlordane **Inorganics:** Aluminum Barium Beryllium Cadmium Cobalt Copper Iron Lead Manganese Mercury Nickel Selenium Thallium Vanadium Zinc

TABLE C-1 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Fish	**Pesticides:** beta-BHC gamma-BHC (Lindane) Heptachlor Aldrin Heptachlor epoxide Dieldrin 4,4'-DDE Endrin 4,4'-DDD 4,4'-DDT alpha-Chlordane **Inorganics:** Arsenic Cadmium Chromium Copper Iron Mercury Selenium Silver Vanadium Zinc
Crab	**Pesticides:** beta-BHC gamma-BHC (Lindane) Heptachlor Aldrin Dieldrin 4,4'-DDE 4,4'-DDD 4,4'-DDT alpha-Chlordane **Inorganics:** Arsenic Cadmium Copper Lead Selenium Zinc

TABLE C-2
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Freshwater Stations			Saltwater Stations			Surface Soil	Fish Samples		Crab Samples
	Surface Water		Sediment	Surface Water		Sediment		Fillet	Whole Body	
	Aquatic Receptors	Terrestrial Receptors		Aquatic Receptors	Terrestrial Receptors					
Volatiles: 1,2-Dichloroehene		X								
Toluene							X	X	X	
Semivolatiles: Benzo(b)fluoranthene							X			
Bis(2-ethylhexyl)phthalate							X			
Butylbenzylphthalate							X			
Diethylphthalate			X			X				
Fluoranthene							X			
Indeno(1,2,3-cd)pyrene							X			
Phenanthrene							X			
Pyrene							X			
Pesticides/PCBs: Aldrin							X	X	X	X
Beta-BHC								X	X	X
Gamma-chlordane								X	X	X
Alpha-chlordane						X	X	X	X	X
Gamma-chlordane							X		X	
4,4'-DDE		X				X	X	X	X	X

TABLE C-2 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Freshwater Stations			Saltwater Stations			Surface Soil	Fish Samples		Crab Samples
	Surface Water		Sediment	Surface Water		Sediment		Fillet	Whole Body	
	Aquatic Receptors	Terrestrial Receptors		Aquatic Receptors	Terrestrial Receptors					
Pesticides/PCBs (Cont.): 4,4'-DDD		X				X	X	X	X	X
4,4'-DDT		X				X	X	X	X	X
Dieldrin						X	X	X	X	X
Endosulfan I							X			
Endosulfan II								X	X	
Endosulfan sulfate			X							
Endrin			X					X	X	
Endrin aldehyde			X			X		X	X	
Endrin ketone			X					X	X	
Heptachlor								X	X	X
Heptachlor epoxide							X	X		
Aroclor-1248							X			
Aroclor-1254							X			
Inorganics: Aluminum			X	X		X	X	X	X	X
Antimony		X			X		X			
Arsenic							X	X		X

TABLE C-2 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 36, CAMP GEIGER AREA DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Freshwater Stations			Saltwater Stations			Surface Soil	Fish Samples		Crab Samples
	Surface Water		Sediment	Surface Water		Sediment		Fillet	Whole Body	
	Aquatic Receptors	Terrestrial Receptors		Aquatic Receptors	Terrestrial Receptors					
Inorganics (Cont.): Barium	X	X		X			X	X	X	
Beryllium			X			X				
Cadmium			X		X	X	X	X	X	X
Chromium							X	X	X	
Cobalt	X		X			X	X			X
Copper	X	X	X	X			X	X	X	X
Iron	X	X		X	X		X	X	X	X
Lead	X		X			X	X		X	X
Manganese	X	X		X	X		X	X	X	X
Mercury						X	X	X	X	
Molybdenum		X		X	X					
Nickel		X	X	X	X		X			
Selenium							X	X	X	X
Silver							X			
Thallium			X		X	X				
Vanadium	X	X	X		X	X	X	X		
Zinc							X	X	X	X

TABLE C-3
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 43, AGAN STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Surface Soil	**Semivolatiles**: Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenzo(a,h)anthracene **Pesticides**: 4,4-DDD **Inorganics**: Aluminum Barium Iron Chromium
Subsurface Soil	**Semivolatiles**: Benzo(a)pyrene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene **Inorganics**: Iron
Groundwater	**Inorganics**: Aluminum Iron
Surface Water	**Volatiles**: 1,2-Dichloroethene (total) **Pesticides/PCBs**: 4,4-DDE 4,4-DDD **Inorganics**: Aluminum Arsenic Barium Copper

TABLE C-3 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 43, AGAN STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Surface Water (continued)	Iron Lead Manganese Vanadium
Sediment	**Volatiles**: Carbon Disulfide 4-Methylphenol Pyrene **Semivolatiles**: Bis(2-ethylhexyl)phthalate Benzo(a)pyrene **Pesticides/PCBs**: 4-4'-DDE Endrin 4-4'-DDD 4-4'-DDT alpha-Chlordane gamma-Chlordane **Inorganics**: Aluminum Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Iron Lead Manganese Mercury Nickel Selenium Silver Vanadium Zinc

TABLE C-4
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 43, AGAN STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water		Sediment	Surface Soil
	Aquatic Receptors	Terrestrial Receptors		
Volatiles Acetone			X	
Carbon disulfide			X	
1,2-Dichloroethene		X		
Semivolatiles Acenaphthene				X
Anthracene				X
Benzo(a)anthracene				X
Benzo(b)fluoranthene				X
Benzo(k)fluoranthene				X
Benzo(g,h,i)perylene				X
Benzo(a)pyrene			X	X
Bis(2-ethylhexyl)phthalate			X	X
Butylbenzylphthalate				X
Carbazole				X
Chrysene				X
Dibenzo(a,h)anthracene				X
Fluoranthene				X
Fluorene				X
Indeno(1,2,3-cd)pyrene				X
Phenanthrene				X
Pyrene				X
Pesticides/PCBs Alpha-chlordane			X	
Gamma-chlordane			X	
4,4'-DDE	X	X	X	X
4,4'-DDD	X	X	X	X
4,4'-DDT			X	X
Endrin			X	
Endrin aldehyde				X
Heptachlor epoxide				X

TABLE C-4 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 43, AGAN STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water		Sediment	Surface Soil
	Aquatic Receptors	Terrestrial Receptors		
Inorganics Aluminum	X	X	X	X
Arsenic		X		
Barium	X	X		X
Cadmium			X	X
Chromium				X
Cobalt			X	X
Copper	X	X	X	X
Iron	X	X		X
Lead		X	X	X
Manganese	X	X		X
Mercury			X	X
Nickel				X
Selenium			X	
Silver			X	
Vanadium		X	X	X
Zinc			X	X

TABLE C-5
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 44 - JONES STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Surface Soil	**Inorganics**: Aluminum Arsenic Copper Iron
Subsurface Soil	**Inorganics**: Aluminum Arsenic Iron
Groundwater	**Volatiles:** Vinyl Chloride Carbazole **Inorganics:** Arsenic Iron
Surface Water	**Volatiles:** Vinyl Chloride Acetone 1,1-Dichloroethene 1,2-Dichloroethene (total) Trichloroethene 1,1,2-Trichloroethane 1,1,2,2-Tetrachloroethane **Semivolatiles:** Phenol bis(2-Ethylhexyl)phthalate **Inorganics:** Aluminum Barium Copper Iron Lead Manganese Nickel Vanadium Zinc

TABLE C-5 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 44 - JONES STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Sediment	**Volatiles:** Acetone **Semivolatiles:** Pentachlorophenol Phenanthrene Carbazole Fluoranthene Pyrene Butylbenzylphthalate Benzo(a)anthracene Chrysene Bis(2-ethylhexyl)phthalate Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Benzo(g,h,i)perylene **Pesticides/PCBs (µg/kg):** Aldrin Heptachlor epoxide 4,4'-DDE 4,4'-DDD 4,4'-DDT alpha-Chlordane gamma-Chlordane **Inorganics:** Aluminum Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Iron Lead Manganese Nickel Selenium Silver Vanadium Zinc

TABLE C-6
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 44, JONES STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water		Sediment	Surface Soil
	Aquatic Receptors	Terrestrial Receptors		
Volatiles Acetone	X	X	X	X
2-Butanone			X	
1,1-Dichloroethene		X		
1,2-Dichloroethene		X		
1,1,2,2-Tetrachloroethane		X		
1,1,2-Trichloroethane	X	X		
Trichloroethene		X		
Vinyl chloride		X		
Semivolatiles Benzo(g,h,i)perylene				X
Bis(2-chloroethyl)ether				X
Bis(2-ethylhexyl)phthalate		X		X
Butylbenzylphthalate			X	
Carbazole			X	
Chrysene			X	
2,6-Dinitrotoluene				X
Fluoranthene			X	
Indeno(1,2,3-cd)pyrene				X
Pentachlorophenol			X	
Phenanthrene			X	
Phenol		X		
Pesticides/PCBs Aldrin			X	
Alpha-chlordane			X	
Gamma-chlordane			X	
4,4'-DDE			X	X
4,4'-DDD			X	X
4,4'-DDT			X	X
Heptachlor epoxide			X	

TABLE C-6 (continued)
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 44, JONES STREET DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water		Sediment	Surface Soil
	Aquatic Receptors	Terrestrial Receptors		
Inorganics Aluminum	X	X	X	X
Arsenic				X
Barium	X	X		X
Chromium				X
Cobalt			X	
Copper	X	X		X
Iron	X	X		X
Lead	X	X	X	X
Manganese	X	X		X
Nickel	X	X		
Selenium			X	
Vanadium		X	X	X
Zinc		X		X

TABLE C-7
CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 54 - CRASH CREW FIRE TRAINING BURN PIT
MCB, CAMP LEJEUNE, NORTH CAROLINA

Environmental Medium	COPC
Surface Soil	**Inorganics**: Arsenic
Subsurface Soil	**Inorganics**: Aluminum Arsenic
Groundwater	**Volatiles**: 1,2-Dichloroethene (total) Benzene Toluene **Semivolatiles**: Nitrobenzene Naphthalene 2,-Methylnaphthalene **Inorganics**: Aluminum Arsenic Iron Lead Manganese

TABLE C-8
CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE ECOLOGICAL RISK ASSESSMENT
RECORD OF DECISION, CTO - 0219
SITE 54 - CRASH CREW FIRE TRAINING BURN PIT
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Aquatic Receptors	Surface Soil
Volatiles Xylenes	X	
Semivolatiles Anthracene	X	
Bis(2-ethylhexyl)phthalate		X
Butylbenzylphthalate		X
2,4-Dimenthylphenol	X	
Di-n-octylphthalate		X
Fluoranthene		X
2-Methylnaphthalene	X	
Naphthalene	X	
Nitrobenzene	X	
N-nitrosodoiphenylamine		X
Phenanthrene		X
Pyrene		X
Inorganics Aluminum	X	X X
Barium	X	X
Chromium		X
Cobalt	X	
Iron	X	
Lead	X	
Manganese	X	X
Nickel	X	
Vanadium		X
Zinc		X

ATTACHMENT D
ARARs

TABLE D-1
DESCRIPTION OF ARARs FOR SELECTED REMEDIES
OPERABLE UNIT NO. 6, SITES 36, 43, 44 and 54
RECORD OF DECISION, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be taken to attain requirement
Federal Regulatory Requirement	Groundwater	Safe Drinking Water Act (SDWA)	Relevant and Appropriate	Establishes federal Maximum Contaminant Levels (MCLs) for public water supplies.	Groundwater at Site 36 will be monitored until meeting appropriate State and Federal requirements.
Federal Regulatory Requirement	Soil	OSWER Directive for Lead	Relevant and Appropriate	Directive for USEPA OSWER cleanup goals for lead in soil.	The selected land use controls at Site 36 will properly protect potential receptors from areas of lead exceeding this directive.
State Regulatory Requirement	Groundwater	NC Groundwater Standards	Relevant and Appropriate	Establishes allowable levels of organic and inorganic compounds in groundwater.	Groundwater at Site 36 will be monitored until meeting appropriate State and Federal requirements.
State Regulatory Requirement	Groundwater	NC Groundwater Corrective Action	Relevant and Appropriate	Regulations for cleanup of contaminated groundwater.	State regulations will be complied with during the groundwater monitoring process at Site 36.
State Regulatory Requirement	Groundwater	NC Well Construction Standards	Applicable	Construction and abandonment requirements for water wells.	This will be relevant if additional wells need to be installed at Site 36 to the monitoring program. State regulations will be followed.
State Regulatory Requirement	Soil, Groundwater	NC Recordation of Inactive Hazardous Substance or Waste Disposal Sites	Relevant and Appropriate	State requirement for recordation of inactive hazardous waste sites	PLAT Maps will be developed for OU 6 to designate areas of remaining soil and/or groundater contamination that require land use controls.
State Regulatory Requirement	Soil, Groundwater	NC Coastal Management	Applicable	Guidelines for areas of environmental concern.	Because Sites 36 and 43 are located alongside of Brinson and Strawhorn Creek, Coastal Management may be considered an ARAR at this site.
State Regulatory Requirement	Soil, Groundwater	NC Endangered Species Act	Applicable	Similar to the Federal Endangered Species Act, but also includes state special concern species, state significantly rate species, and the state watch list.	Since the American alligator has been sighted within MCB, Camp Lejeune, this will be considered an ARAR.

ATTACHMENT E
TRANSCRIPT OF JUNE 18, 2002 MEETING MINUTES

COPY

MARINE CORPS BASE (MCB)
CAMP LEJEUNE, NORTH CAROLINA

PUBLIC MEETING PRESENTATION

FOR

FOR OPERABLE UNIT (OU) NO. 19 (SITE 84/BUILDING 45 AREA)

AND OPERABLE UNIT (OU) NO. 6 (SITES 36, 43, 44, AND 54)

June 18, 2002
Coastal Carolina Community College
Jacksonville, North Carolina

Reported by:

Kathryn F. Kilpatrick
Carolina Court Reporters, Inc.
105 Oakmont Professional Plaza
Greenville, North Carolina 27858
252-355-4700
800-849-8448
Fax: 252-355-4707

TABLE OF CONTENTS

sites.

MR. JAMES BANKS: One point of curiosity is you're taking the PCBs out of the ground there and you're putting them in the landfill. What's going to happen a hundred years from now with the landfill? Are we going to dig them up there and move them some place else, or --

MR. RAINES: Well, our landfill is actually -- it's lined, isn't it, and we collect the leachate off of it? It's double-lined, we collect the leachate. When they're through building on it, they cap it, so there's very little water. And the big problem here is water flushing though it, it getting into the groundwater and eventually dispersing. That's not going to happen in the landfill, and if it does, we can collect all the runoff. So -- and eventually, this stuff will break down, but we have more control over what it does in the landfill.

PRESENTATION FOR OU NO. 6 (SITES 36, 43, 44, AND 54)

MR. RICH BONELLI: My name is Rich Bonelli with Baker, and I'll be speaking to you tonight about Operable Unit No. 6, which is comprised of Sites 36, 43, 44, and 54. As far as the Operable Unit history, OU No. 6 was formed back in the early '90's. It originally included five sites, that's Site 43, 44, 36, 54, and 86. The initial RI/FS/PRAP documents were completed between 1996 and 1998. A public meeting was initially held, also, in 1998, to discuss those findings. However, because of some issues dealing with Site 86 in Brinson Creek, which is where Site 36 is, the ROD was not signed at that time, and additional sampling was done.

Later, in 19 -- July of 2000, Site 86 was removed from Operable Unit No. 6 into a new OU, and lastly, right now, the ROD that we spoke about earlier is in progress. Operable Unit No. 6 is located at the Camp Geiger Air Station Area. Sites 43, 44, and 36 are located within Camp Geiger, and Site 54 is located just off one of the taxiways at the air station. Site 36, talk a little bit about the history, description of the site. The site is about 20 acres. It's very heavily wooded. It's located on the southern portion of Brinson Creek. It's about a thousand feet, give or take, east of Camp Geiger, and very close to the New River. Currently, as many of you may know, the bypass from Highway 17 extends to the western portion of the site. Regarding the history, the site was used back in the '40's and '50's for a variety of different disposal activities. Mostly, municipal types of waste from Camp Geiger were dumped at the site. This included mixed waste, some waste oils, as well as some hydraulic fluids. Material was, apparently, from what we understand, was first disposed of and then later burned on the surface. This is a site map showing the boundary of the site. The original dump area was about 3 acres, and was located, primarily, on the eastern part of the site. Brinson Creek borders the site to the north. The bypass they spoke of, you kind of see here is this dash line, here. There is an on-ramp that extends from the motor pool area of Camp Geiger to an overpass, and that's how right now you basically can get onto the site. There's a fence that runs along here and along here, so access to the site, currently, is very difficult to get to. It's primarily through going through the

motor pool area and coming on this way. And lastly, there's an unnamed tributary at Brinson Creek, which is located on the southern part of the site. Typical shot of Site 36; again, very heavily wooded. There are some dirt roads that go through it, and this is very typical of most of the site. A number of investigations have been conducted at Site 36, starting back in 1983, with the initial assessment study. From there, there were the confirmation/verification studies from 1984 through 1987. There was an aerial photographic study done at the site that looked at historical photographs, identified disposal areas. In 1994, Baker conducted the Pre-RI sampling, followed by the RI investigation from 1995 to 1996. A time-critical removal action was performed in 1997 for some PCBs at the site. In 1997, additional fish samples were collected from Brinson Creek. In 2000, temporary monitoring wells were installed on the north side of Brinson Creek to determine if volatile organic compounds in the groundwater had migrated off-site. And lastly, the Post-RI sampling, which has gone on from 1998, and is currently going on right now, which focuses primarily on groundwater and surface water from Brinson Creek.

I'm going to talk mostly about the RI investigation right now. The RI, again, was conducted in 1995 and 1996. We looked at a number of different media: soil sampling, which entailed about 66 borings, 109 samples total. We dug seven test pits at the site to look for former disposal areas. Groundwater samples were collected from 16 monitoring wells, some of which were existing,

some of which were new monitoring wells. We sampled both the surficial and Castle Hayne aquifers. Surface water and sediment samples were collected, both along Brinson Creek and the unnamed tributary that I spoke of. And lastly, biological samples, mostly fish and benthic samples, were collected from Brinson Creek. Sort of a difficult map to read, but it kind of gives you a gist of the sampling program. The points in green represent soil boring locations. The points in red throughout represent groundwater monitoring points. Points in purple along Brinson Creek and the unnamed tributary represent surface water and sediment locations. The test pits were dug, primarily, in the area around the former, what was called the original part of the landfill, the dump area down here, up in this area, here, and this area right here. As far as the results and recommendations that came out of the RI, we found -- PAHs, pesticides, PCBs, and lead were detected above the screening criteria for soil samples. We also identified volatile organic compounds in the groundwater. There was a groundwater -- basically, there was a groundwater plume in the northern part of the site, which I'll speak about in a few minutes, here. We also identified organics and inorganics in the surface water and sediment samples in both Brinson Creek and the unnamed tributary. And metals, primarily arsenic, lead, and mercury, and some pesticides were also detected in some of the fish samples that were collected from Brinson Creek. Some of the recommendations that came out of the RI, the first one being to perform a time-critical removal action for an area of PCBs that were primarily in the

surface soils. We also recommended that groundwater samples and surface water samples be continued to be collected at the site after the RI. The recommendation that I spoke of earlier was we went out and started monitoring wells on the opposite side of Brinson Creek, off-Base property, to determine if the volatile organic compounds had migrated underneath the creek and were impacting off-Base property. And lastly, the recommendation to collect additional fish samples from Brinson Creek, primarily because the sample that we collected during the RI, we collected a very, very small data set, and we had a very hard time collecting a sufficient volume of fish samples to get an analysis done. For example, I believe we only caught, or were able to analyze, two or three samples for largemouth bass. So we had a very difficult time getting sufficient sample volumes for the fish samples. As far as some of the areas, like -- which I spoke of as far as being impacted, the PCB area was up around here, this area, here, that were removed. We also found levels of pesticides and PCBs in those levels -- pesticides and PAH, I should say, primarily in this area, here. The lead contamination that we found in the soil was primarily from the original landfill area, here, and of course, the sample we collected from Brinson Creek in this area, here.

The groundwater plume which I spoke of is in the northern part of the site in this area, here. Again, what we wanted to do is to make sure that contaminants were not reaching the northern side of the creek, and that's when we went out there and put additional temporary monitoring wells in to sample. That plume is

existing right now, but it's primarily in the surficial aquifer.

Some of your site risks from performing the human health risk assessment, there was a potential risk to fishermen from the ingestion of fish or crab tissues, crab we did find within Brinson Creek. This was primarily from the arsenic, the mercury, and the lead that was found. There was also a risk to future children and adult residents at the site if that were ever to happen. This was an unacceptable non-carcinogenic risk posed primarily from the ingestion of lead in groundwater -- excuse me, iron in groundwater.

And lastly, there was also an unacceptable risk, a non-carcinogenic risk, from the lead that we found in the soil, and that was primarily from being potentially exposed to the maximum concentration of the soil -- of the lead we found in the soil. The highest concentration, basically, was in the subsurface, and as Jeff spoke of earlier, that's primarily at a depth below 1 foot.

A time-critical removal action was performed in 1997 for PCBs. At that time, approximately 92 tons of regulated PCB contaminated soils were removed, and about 184 tons of non-regulated PCB contaminated soil was removed.

A quick summary about the Post-RI sampling investigations that we performed. Again, the samples we collected across Brinson Creek for groundwater were non-detect for the volatile organic compounds. Currently, we have the Post-RI groundwater and surface water program going on. To date, since 1998, there's been about 14 rounds of samples collected. What we have found is that the TCE concentration that we found during the RI was somewhere around 97

parts per billion. Those concentrations right now are about half of that, that we've found through our monitoring program. And what, basically, the data is suggesting is the concentrations of TCE is pretty stable right now. It's somewhere between 40 and 45 parts per billion right now.

Next, we move on to Site 43, which is known as the Agan Street dump. The site is located at the northern terminus of Agan Street, behind the Base housing area. The site is about 11 acres, and much like Site 36, is very heavily wooded. The site is bounded by Strawhorn Creek and Edwards Creek, the site boundary area. The history; Site 43 was a former dump area, primarily from construction debris from the housing area. It was also reported that sludge from a former sewage treatment plant in the area was also disposed of at this site.

The site drawing; basically, what you have right now are just kind of dirt roads which go through the site area, here, in green. Strawhorn Creek borders the site here and here, and Edwards Creek is a little bit further to the north, just off the map. A shot of Site 43, and again, this is very common. A picture for the rest of the site, very heavily wooded, and what you're seeing right now is a photograph of a monitoring well that's still at the site itself. As far as the investigations, we performed a number of investigations much like Site 36, starting out with the initial assessment study in 1983. There was a Pre-RI, or site inspection, completed by Baker in 1991. The RI study was completed in 1995 -- in 1996, and lastly, a time-critical removal action was performed

in 1995 for surficial metallic debris. The RI itself, again, much like Site 36, looked at a number of various types of media. Soil investigation included about 20 borings with a collection of 52 samples. We dug roughly about five test pits at the site. Groundwater samples were collected from six monitoring wells, some of which were existing from the site inspection, some of them were newly installed during the RI. And lastly, surface water and sediment samples were collected from both Strawhorn Creek and Edwards Creek.

As far as the investigation itself, the samples, again the soil samples are located here in green. The monitoring wells, or temporary monitoring wells, are shown here in red. The test pits were dug up in this area, here, and are represented by the rectangles. And the surface water and sediment samples were collected, again, from Strawhorn Creek, as well as Edwards Creek which, again, is just off the map here.

As far as the results and recommendations that came out of the RI, PAHs were found in several areas above the screening criteria. There were no significant impacts to groundwater from the groundwater samples that we collected, and there were organics and inorganics detected, primarily from Edwards Creek. And what we found were mostly volatile organic compounds in the surface water of Edwards Creek. Prior to Post-RI investigative sampling, it was determined that the VOCs in the surface water at Edwards Creek were not originating from Site 43, but were originating up-site -- up gradient at Site 89, which I think a lot of you are familiar with.

Really the only main recommendation that came out of that RI at that time was to perform a time-critical removal action for the surficial metallic debris. At the site itself, there was a lot of old debris, metallic substances, just basically junk that was under the surface, and it was recommended at that time that that material be removed from the site.

Again, going back to the site drawing, that metallic debris which I spoke of was pretty much scattered throughout the entire site. It was not just one area in particular, it was throughout. The levels of PAHs that I spoke of, the higher levels of PAHs, I believe were up in this area right here, just off this dirt path.

As far as the risk assessment would show, there were no current unacceptable risks to human health. There was a risk from ingestion of iron that were looked at for future residents, meaning again if a monitoring well or a supply well was put in at the site itself, ingestion of iron potentially could cause unacceptable non-carcinogenic risks.

Time-critical removal action, summarize that very quickly here. Again, surface debris was removed from the site. Drums, scrap metals, an old tank vehicle were all taken off-site. Additionally, about 1400 pounds of waste material were also removed from the site itself.

Moving on, now, to Site 44; Site 44 is known as the Jones Street dump. The site is about five acres, again, very heavily wooded, and is bordered on the north by Edwards Creek. The

history, again, much like Site 43. The site was used as a dump area. Reportedly, construction debris, again from the housing area, as well as potentially minor quantities of potentially hazardous debris and liquids were also possibly disposed at the site.

The site drawing; this looks very much like Site 43. Here is the housing area. In fact, you're seeing the houses, you see right here. Access is right here. It's through a locked gate right here. There are some dirt roads throughout the site, and again, it's very heavily wooded. To the north you have Edwards Creek, right in this area, here. Just for reference purposes, Site 44 is here. Site 89, which I spoke of earlier, is just kind of up gradient here, and Site 43 is somewhere along -- would be sitting right about here, along Edwards Creek.

This is a shot of Site 44. Again, access to the site itself is through a fence, a locked gate. The shot -- the photograph right now that you're looking at is a photograph taken from the back yard of one of the houses, standing at -- and again, as you see, the site is very heavily wooded.

The investigations at 44 were much like they were performed at Site 43. IAS was performed in 1983, site inspection in 1991, and the RI/FS investigation was performed in 1995 and 1996.

Investigation activities, again we looked at the soil. Thirteen borings were installed, 30 samples were collected. We also dug some test pits. I think there were three test pits dug in

total. Eight monitoring wells, some of which, again, were existing from the SI investigation. We also installed some additional wells during the RI. And lastly, surface water and sediment samples were collected from Edwards Creek.

A little difficult to see; again, the points in green represent the soil borings. The points in red represent the monitoring wells. Samples along here, kind of tough to see, we collected these from the surface water and the sediment from Edwards Creek, and the test pits were dug up in this area, here. We know about the results and recommendations from the Site 44 RI; there were no significant levels of organics and inorganics detected in the soil or groundwater. There was one detection of a volatile organic compound in one of our temporary monitoring well sites. The location of that temporary monitoring well was actually within the flood plain of Edwards Creek, so we determined that it wasn't the groundwater at the site that was impacted, it was really the surface water from Edwards Creek that impacted that monitoring well. And we know, again, that the VOC detected in Edwards Creek did not originate from this site, but rather from upstream at Site 89.

As far as recommendations, at the time of the RI, there were no significant or no major recommendations made for this site, primarily because in looking at the site risks, we did not find any really current, unacceptable human health risks at the site through the risk assessment process.

Moving on, now, to Site 54, a description and history;

Site 54 is located at the far end of runway 5-23 at the air station. The site itself is about 1.5 acres, and it is the fire training area, which I think some of you may have visited at one time. I'm not sure if you got a chance to see that. The site itself originated back in the '50's. It was an unlined pit, and at that time, various types of solvents, petroleum products, were put in the ground, put out as part of a training session for the air station folks. In 1995 (sic), a lined pit was installed at the site and, again, at that time, using various types of fuels, waste oils, and those type of things to start the fire. April 2001, a new facility was installed, and it's currently being used right now. The site map of Site 54, this is about the location, here, of the former burn pit. The new training facility is located just to the left, here. There is a ditch that runs right along this area, here, which I think is still present, and the runway -- the air station part is just to the north, up in here.

There's a shot of the new simulator, which is being used right now. This new facility, rather than using fuels, uses propane, so they have gone to a cleaner source for their practice, for their training exercises.

Investigation of Site 54; going back, again, 1983, to the initial site assessment studies. There was a confirmation/ verification study done in 1984 through 1987. Baker conducted the RI at the site in 1995 and 1996. There was a removal action done of POL soils in 2001 as part of the installation of the new facility, and Post-RI monitoring sampling has been going on since

STATE OF NORTH CAROLINA)

) C-E-R-T-I-F-I-C-A-T-I-O-N

COUNTY OF LENOIR)

I, KATHRYN F. KILPATRICK, A COURT REPORTER AND NOTARY PUBLIC IN AND FOR THE AFORESAID COUNTY AND STATE, DO HEREBY CERTIFY THAT TO THE BEST OF MY KNOWLEDGE, THE FOREGOING PAGES ARE AN ACCURATE TRANSCRIPT OF THE PUBLIC MEETING PRESENTATION FOR OPERABLE UNIT (OU) NO. 19 (SITE 84/BUILDING 45 AREA) AND OPERABLE UNIT (OU) NO. 6 (SITES 36, 43, 44, AND 54), HELD IN JACKSONVILLE, NORTH CAROLINA, WHICH WAS TAKEN BY ME BY STENOMASK AND TRANSCRIBED BY ME PERSONALLY.

I FURTHER CERTIFY THAT I AM NOT FINANCIALLY INTERESTED IN THE OUTCOME OF THIS ACTION, A RELATIVE, EMPLOYEE, ATTORNEY OR COUNSEL OF ANY OF THE PARTIES, NOR A RELATIVE OR EMPLOYEE OF SUCH ATTORNEY OR COUNSEL.

WITNESS, MY HAND AND SEAL, THIS DATE: JUNE 29, 2002.

MY COMMISSION EXPIRES MAY 2, 2006.

Kathryn F. Kilpatrick

KATHRYN F. KILPATRICK
COURT REPORTER AND NOTARY PUBLIC
CAROLINA COURT REPORTERS, INC.
105 OAKMONT PROFESSIONAL PLAZA
GREENVILLE, NC 27858